Impact of the Army Continuing Education System (ACES) on Soldier Retention and Performance
Phase I: Plan Development

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14. ABSTRACT *(Maximum 200 words):*

The U.S. Total Army Personnel Command requested an evaluation of the Army Continuing Education System (ACES) to demonstrate its value in improving enlisted soldier retention and performance. This report describes the planning of the evaluation, including a review of the relevant research literature and the development of evaluation and database development plans.

The research literature provides limited coverage of continuing education programs. Results indicate that those who participate in continuing education tend to be better qualified than those who don't. The research suggests that participation in continuing education increases the likelihood of reenlistment and improves performance. The effect remains at a reduced magnitude when other factors are controlled statistically.

The evaluation plan addresses five ACES programs: (a) the Army Tuition Assistance (TA) Program, (b) the Service members Opportunity Colleges Army Degree (SOCAD) Program (c) the Functional Academic Skills Training (FAST) program, (d) Military Occupational Specialty (MOS) Improvement Courses, and (e) Non-commissioned Officer (NCO) Leader Development Courses. The methodological approach addresses several potential evaluation problems, including non-random assignment, censored data, missing data, measurement error, and unobserved heterogeneity. The database development plan specifies the variables needed to conduct the evaluation, and identifies data-building procedures that will result in an analytically relevant evaluation database.

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IMPACT OF THE ARMY CONTINUING EDUCATION SYSTEM (ACES) ON SOLDIER RETENTION AND PERFORMANCE

PHASE I: PLAN DEVELOPMENT

EXECUTIVE SUMMARY

Requirement:

The U.S. Total Army Personnel Command (PERSCOM) requested an evaluation of the Army Continuing Education System (ACES) to demonstrate its value in the areas of retention and soldier performance for enlisted soldiers. The evaluation consists of two phases. Phase I is the development of an evaluation plan to collect and analyze the data. Phase II consists of data collection and analysis. This report describes the planning effort that was conducted in Phase I of the evaluation.

Procedure:

The effort included a review of the relevant research and evaluation literature and the preparation of evaluation and database development plans. The literature review covered relevant reports in both the military and civilian research literatures. Military research directly evaluated ACES components, comparable programs in other Services, or Department of Defense (DoD)-wide continuing education programs. The civilian literature provided information regarding analogous programs.

The evaluation plan was based on the results of the literature review and on discussions with PERSCOM regarding the nature of specific ACES programs. The plan assesses the effect of five selected ACES programs on soldier retention and performance. The planned analysis of retention considers reenlistment and early attrition, while the analysis of performance focuses on promotion and reclassification. In addition, the planned evaluation includes a cost-effectiveness analysis of ACES programs.

The preparation of the database development plan began with a thorough assessment of the data required for the evaluation. This effort identified specific criteria by which to assess and select data sources and evaluated relevant data sources according to these criteria. The selected data sources were judged to provide the richest, most efficient, and most relevant information for use in the evaluation study. The final step developed detailed guidelines for data procurement and for the creation of an analytic database to support the evaluation.

Findings:

The research literature provides limited coverage of continuing education programs. Results indicate that those who participate in continuing education tend to be better qualified and more highly motivated soldiers (or employees) than those who don't. A positive effect of

participation on performance is reflected in personal opinions, promotion rates, and actual performance ratings. Regarding retention, the research suggests that participation in continuing education increases the likelihood of reenlistment. The effect remains at a reduced magnitude when other factors are controlled statistically. The generality of the findings of past research is limited by the relatively small number of evaluation studies, the focus of these studies on a small number of continuing education programs (primarily tuition assistance), the inconsistent correction for selection bias, and the lack of an overall conceptual model to guide the selection of predictor variables and interpretation of results.

The evaluation plan addresses five ACES programs: (a) the Army Tuition Assistance (TA) Program, (b) the Servicemembers Opportunity Colleges Army Degree (SOCAD) Program (c) the Functional Academic Skills Training (FAST) program, (d) Military Occupational Specialty (MOS) Improvement Courses, and (e) Non-commissioned Officer (NCO) Leader Development Courses. The methodological approach addresses several potential evaluation problems, including non-random assignment, censored data, missing data, measurement error, and unobserved heterogeneity. The database development plan specifies variables from administrative databases and surveys that measure participation in ACES programs, assess retention and performance outcomes, and identify other characteristics that should be used as controls. The plan also identifies data-building procedures that will result in an analytically relevant evaluation database.

Use of Findings:

The products of this Phase I effort – the literature review, evaluation plan, and data development plan – provide sound guidelines and procedures for the Phase II ACES evaluation study.

IMPACT OF THE ARMY CONTINUING EDUCATION SYSTEM (ACES) ON SOLDIER RETENTION AND PERFORMANCE

PHASE I: PLAN DEVELOPMENT

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INTRODUCTION

The Army's role as educator began in 1778 during the Revolutionary war when General Washington ordered chaplains to teach convalescent soldiers how to read. However, it was not until the 20th century that educational benefits became more widely available to both veterans and active duty servicemembers. The Rehabilitation Act of 1919 provided educational assistance to veterans who were disabled in World War I. By the end of World War II, educational benefits were offered to all veterans by the Servicemen's Readjustment Act of 1944, better known as the G.I. Bill of Rights. Further expansion of benefits for Vietnam Era veterans, passed by Congress in 1966, offered educational assistance to active duty servicemembers.

With the advent of the All Volunteer Force in 1973, the Military Services and Department of Defense (DoD) increased educational benefits to serve as an incentive for recruitment and to encourage recruits to select critical Military Occupational Specialties (MOS). The current Montgomery G.I. Bill (MGIB), enacted in 1985, provides up to 36 months of educational assistance that can be used by both veterans and active duty servicemembers.

Realizing the need for continuing education (CE) among its members, the Services and DoD established programs to support the volunteer, off-duty educational activities of enlisted personnel and officers. The Army Continuing Education System (ACES) represents a series of programs that are available to soldiers and, in some cases, their dependents and Army civilian personnel. The mission of ACES is to vigorously promote lifelong learning opportunities to sharpen the competitive edge of the Army by providing and managing quality educational programs and services. ACES includes the following programs to meet the educational needs of soldiers and to help soldiers to apply the skills learned in the Army to obtain academic credentials needed for their later civilian life.

- The American Council of Education Military Evaluations Program reviews formal military training courses to determine the extent to which they are equivalent to college courses. Soldiers can gain college credit for their military experience through this program.

- The Army Personnel Testing Program provides the soldier with the opportunity to take standardized tests that are used for selection and classification purposes.

- The Army Tuition Assistance (TA) Program helps soldiers to finance voluntary participation in off-duty postsecondary educational programs.

- The Functional Academic Skills Training (FAST) Program provides soldiers with instruction to enhance basic skills necessary for job proficiency or career progression.

- The English as a Second Language (ESL) program provides education to increase language proficiency among non-native speakers.

- Leader Development Programs provide opportunities to obtain the skills required by non-commissioned officers (NCO) to effectively lead their troops.

- The High School Completion Program provides soldiers and their adult family members an opportunity to earn a high school credential.

- The Servicemembers Opportunity Colleges Army Degree (SOCAD) Program allows soldiers to earn a job-related college degree at locations on or near Army installations.

- The Army/American Council on Education Registry Transcript System provides a transcript that translates a soldier's military experience into civilian terms.

The ACES Program is administered by the Education Division, U.S. Total Army Personnel Command (PERSCOM). Education counselors located at installation Army Education Centers coordinate soldier participation in ACES programs.

PERSCOM requested an evaluation of ACES to demonstrate its value to the Total Army in the areas of retention and performance of enlisted soldiers. The evaluation consists of two phases. Phase I is the development of evaluation and database development plans to collect and analyze the data. Phase II consists of data collection and analysis. This report describes Phase I, which consists of three components—a literature review, an evaluation plan, and a database development plan.

The primary purpose of the literature review is to provide input for the evaulation and database development plans that follow it in this report. More specifically, the review of the military and civilian literature on the impact of education program participation on job performance and turnover serves two major purposes.

First, the review provides information to develop a conceptual framework and a model to understand how participation in an education program (like ACES) could affect job performance and turnover. Although the nature of ACES differs in many ways from some of the education programs analyzed in the literature, both the goals of previous studies and the methods used to meet them are relevant to this study. The conceptual model that builds on the extant literature will help determine what information should be collected for the evaluation. This, in turn, affects both the database development plan and the evaluation plan. Also, a review of the theory on the purpose of CE programs and the value added may provide insights for critiquing ACES and suggesting areas for improvement in its design.

Second, our review of the empirical literature provides useful information on many of the data limitations and statistical issues that previous studies have encountered. In the review, we both describe and critique the methods and statistical techniques used by various authors to address these issues. This information, in turn, helps guide the evaluation and database development plans.

The evaluation and database development plans build upon the information identified in the literature review. These two plans were developed in tandem using an iterative process. On one hand, the evaluation plan establishes the requirements for data that must be included in the evaluation database. A major effort in the development of the database development plan is identifying and evaluating sources of the data required by the evaluation plan. On the other hand, the evaluation plan must take into account the constraints brought about by the availability and

quality of relevant data. If the information necessary to evaluate a particular program is not recorded, or is not recorded accurately, then the evaluation plan must be adjusted to reflect this constraint.

The evaluation plan focuses on required independent, dependent, and control variables, and provides a very general description of potential sources for these variables. The database development plan that follows the evaluation plan gives a detailed description of both data sources and procedures used to obtain the required information.

REVIEW OF RELEVANT RESEARCH AND EVALUATION LITERATURE

The most relevant literature included in this review consists of research and studies conducted by or for military agencies. This body of research directly evaluated ACES components, comparable programs in other Services, or DoD-wide continuing education programs. In searching for and identifying relevant reports, we focused on studies that considered the organizational outcome measures of interest—retention, performance, promotion, attrition, or recruiting. In addition, we reviewed studies addressing the reasons people participate in CE, and the individual benefits they obtain from it. The majority of the research that was identified addressed tuition assistance programs. The focus of previous research on this program may reflect its relatively high cost (compared to other CE programs), its importance in the military education system, and the ease with which participation can be quantified. In addition, we were given reports describing evaluation research addressing the Army Basic Skills Education Program (BSEP, a forerunner of FAST) conducted by the U.S. Army Research Institute (ARI). We did not identify any research that evaluated the effects of educational or vocational testing or counseling programs on recruiting, performance, or retention.

Many of the studies we reviewed focused on voluntary education programs for officers. Although the primary focus of this study is enlisted soldiers, a review of the literature focusing on officers serves two purposes. First, the methodology used in these studies can be applied to study the impact of CE on enlisted personnel behavior and outcomes. Second, the review of the officer literature may indicate a need to study the effect of ACES participation among the officers in greater detail. This review of the research addressing officers revealed that motivation for participation in a CE program differs between officers and enlisted personnel.

The civilian literature also provided relevant information for this review. These reports were identified from searches of bibliographic databases, as well as the reference lists from already identified reports. Our focus on specific outcome measures limited the number of reports that were reviewed in greater detail. Interestingly, the private-sector educational programs that were reviewed most thoroughly also focused on tuition assistance for postsecondary education.

Military and civilian employers have similar concerns regarding the demands of recruitment and retention of employees. In the past, providing education/training for employees was for the company's own purpose, to keep workers up-to-date and productive. This is no longer the case in today's job market. A 1998 Saratoga Institute study shows that employee motivation and loyalty are tied, in part, to training and educational benefits—that individuals seek their own development process and not one driven by their employer (Olesen, 1999). A 1999 survey by the Society for Human Resource Management indicates that American business is responding to this need. The survey indicates that to enhance recruiting, 94% of U.S. companies with 5000 or more employees provide professional development and 84% offer educational benefits (Olesen, 1999). A large-scale survey of financial and tuition assistance benefits among the Fortune 1000 companies was published in 1986 (O'Neill, 1986), showing that corporate and military practices are similar in terms of tuition reimbursement rates. Furthermore, Turner (1995) found that since the O'Neill report was published, there has been a trend away from limits being applied to the type of courses for which employees would be reimbursed. In the past, employees would be expected to take courses related to their job or industry. Turner found that nearly two-thirds of those employers surveyed reimbursed personnel

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for non-job-related courses, particularly if they were part of a degree program. These trends in the private sector can act as a benchmark to the military, since, theoretically, these companies and the military are in competition to recruit the same people.

However, differences in the nature of military employment and private sector employment limit the ability to generalize findings from the civilian literature to the military. There are three major differences between the two sectors that are relevant to this study.

- First, the nature of the contractual relationship between employer and employee is different. In the private sector, the employment relationship can be terminated at will. In the military, the soldier and the military enter a contractual relationship that the soldier remain in the military through the end of the enlistment term. Consequently, the relationship between CE participation and turnover in the military and in the private sector may be different.

- Second, the personnel system in the military is a closed hierarchy. That is, leadership positions are filled from lower ranks. In the private sector, management positions may be filled from promotions within the firm, or may be external hires. Consequently, promotions as a measure of job performance are more appropriate for the military than for the civilian sector. Likewise, measures of performance in the civilian sector (e.g., salaries) may not be excellent measures of performance in the military, where there is less variation in pay, and pay is not directly tied to performance.

- Third, the military offers excellent educational benefits for those who leave the military, while private sector firms generally do not. For example, the military aggressively advertises the G.I. Bill and Army College Fund (ACF) benefits, which the soldier use primarily after leaving the military.

Despite these differences in the characteristics of the employment relationship and personnel systems, a review of the civilian literature provides useful information on the methods for evaluating the value added by CE programs.

The remainder of this review summarizes previous empirical studies designed to evaluate the effects of participation in military and civilian continuing education programs. In the next section of the report, we review the literature examining the motivations for participation in continuing education programs and the characteristics of people who participate. The following section reviews the literature examining the benefits of these programs for the organization, focusing on recruiting, performance, and turnover. The report continues with a discussion of empirical and methodological problems and issues encountered in the evaluations of these programs. The final section summarizes the results of the review and discusses the implications on the design of an evaluation of ACES.

Factors Predicting Participation in Continuing Education Programs

This section's focus is on the factors that contribute to an individual's propensity to participate in voluntary, off-duty educational opportunities. It is important to know who participates in CE programs and why. First, the fact that participants are a self-selected sample

may bias the data used to establish a relationship between CE participation and measures of retention or performance. Understanding more about which individuals participate and why will ameliorate some of the problems associated with this bias. Second, it is useful to know characteristics about the individuals that participate. Knowledge of these characteristics drives the research questions and provides expectations that can validate or invalidate models.

This section begins by reviewing the literature analyzing the individual motivations to participate in CE programs. Because there generally has been no well-defined theory driving the studies reviewed below, the models of participation have been defined more by the data. Because they lack theory-driven designs, these studies tend to use typical demographic characteristics to help predict participation.

Motivations Associated with CE Participation

It is important to understand that motivation varies between officers and enlisted personnel, and likewise between military and civilian participants. A review of the civilian literature is included as a point of comparison. Though the civilian literature on the value of participation in voluntary education, particularly in the business sector, is generally more hortatory than empirical, some empirical research exists. This literature examines the reasons professionals do or do not participate in continuing and voluntary education.

Military studies. What motivates a soldier to participate in off-duty, voluntary education? Soldiers participate to: (a) improve promotion potential, (b) increase "social standing" or personal satisfaction, (c) increase their ability to change careers or MOS, or (d) improve earnings potential in the private sector. Understanding a soldier's motivation for participating can help focus the research design. For example, if one believes that participation in CE is driven mainly by one's desire to improve promotion potential, and thus military earnings potential, then one would expect that CE participation would lead to higher retention. On the other hand, if one believes that CE participation is to improve earnings potential in the private sector, then one would expect CE participation to lead to lower rates of retention. So, understanding motivation can result in more properly specified retention models.

Brauchle (1998) showed that an individual's motivation to participate in off-duty education is dependent on a number of factors. First of all, the military culture itself values education and is encouraging to servicemembers who use the benefits allotted to them. However, a person's ability to use those benefits is greatly determined by opportunity – opportunity to participate is not constant throughout one's military career but varies based on location, job, and military specialization. Brauchle also found that individual motivation varies throughout one's military career. He notes that servicemembers receive considerable external motivation to participate in off-duty education early in their career. As they progress, that motivation becomes more internalized.

The only other study included in this review that focuses on servicemember's motivations for participating in CE used the Participation Reasons Scale (PRS) to examine the reasons Army Engineers (officers) participated in off-duty, civilian education. The PRS, was created and tested in the late 1970s to help develop education participation models. It was originally validated using businessmen and women as subjects (Catlin, 1982). Grzyb's (1997) analysis identified five

reasons that Army engineers (ranked lieutenant, captain or major) participated in CE: (a) professional improvement/development, (b) personal development and job security, (c) improvement of service to customers, (d) professional identity/perspective, and (e) competence and collegial interaction. Generally, military engineers resembled other professions (judges, physicians, etc.) using this scale. However there were some differences. For example, variables measuring leadership and functional roles, educational level and preparation, occupational specialty, rank and years performing duties, contrary to the expectation, were not associated with an Army Engineer's reasons for participating in continuing education. Grzyb, using structured interviews to complete his research, concluded that Army Engineers shared cultural elements, even set apart from the Army as a whole, that influenced their attitudes and motivation toward participating in voluntary education. For example, leaders repeatedly emphasized participation verbally, in writing and by modeling behavior by participating in off-duty education themselves. The research suggests that organizational culture (shared values) creates norms that can contribute to an individual's propensity to participate in voluntary education.

Civilian studies. The civilian literature on adult voluntary education suggests and often assumes that participation is internally motivated. Recent research suggests that a person's motivation to participate in voluntary education is complex and multi-dimensional, often controlled by external forces. For instance, Stalker (1993) found that employees given educational opportunities viewed the benefit as a favor bestowed on them by authority, and that the opportunity to use these benefits was viewed by both the institution and the employee as a privilege (participants are passive recipients). As Stalker notes, some subtle organizational factors may mandate participation even when participation is, on the surface, considered voluntary. This is relevant to the military since the research analyzing participation in these programs generally assumes internal motivation in order to attain personal goals such as promotion, or simply self-enhancement. What is revealed is that reasons for participation are more difficult to model.

Darkenwald and Valentine (1985) report that earlier studies developing theories about voluntary education participation focused on identification of motivations and typologies of learning behavior (Boshier, 1971; Burgess, 1971; and Boshier & Collins, 1985). Martindale and Drake (1989) note, however, that these studies failed to develop theories that could help practitioners predict participation. Earlier studies also failed to analyze the deterrents to participation in voluntary education opportunities, despite the fact that many studies concluded that a deterrent construct is fundamental to models of participation (Martindale & Drake, 1989; Cross, 1981; Darkenwald & Merriam, 1982). Darkenwald and Valentine (1985) and Scanlan and Darkenwald (1984) developed survey tools incorporating deterrent constructs. The Deterrents to Participation Scale (DPS) and the generic form of this instrument (DPS-G) included factors, such as lack of confidence, low personal priority and time constraints as reasons that individuals refrain from participating in off-duty educational opportunities. These instruments have been used in both civilian as well as military populations to measure deterrents to voluntary education participation.

Focusing on the deterrent effect does not explain what the factors are that contribute to a person's participation in voluntary education. There are numerous studies analyzing the reasons for and motivations of professionals to participate in life-long learning. An instrument that has

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been used consistently in empirical studies to ascertain motivation is the PRS, noted previously. Cervero (1981), Groteleuschen (1985) and Moore, Bennet, Knox, and Kristofco (1994) used the PRS to look at factors contributing to continuing education among physicians, for example. Most people assume that medical professionals are involved in continuing education in order to keep up with new developments in medical techniques, research and technology, and to provide better medical care. Cervero found in analyzing physicians responses on the PRS that the reasons were more complex, showing that physicians participate to enhance their personal and professional position, to interact with colleagues more and to understand themselves in their profession. There have been other studies using participation scales looking at other health professionals, such as nurses (DeSilets, 1995) and veterinarians (Harnish, 1980). The results are similar.

Catlin (1982), using the same methodological approach and PRS instrument, analyzed why Michigan judges participate in continuing education, but included a correlation analysis to determine which personal and professional characteristics correlated with the participation factors. Catlin found that there were three factors that emerged from the analysis: (a) professional perspective, (b) competence, and (c) collegial interaction. This is consistent with the participation rationale for other professionals. The correlation analysis showed that women appear to participate in voluntary education more than men, to maintain an acceptable level of competence and judicial skill. The analysis also revealed that newer judges place a greater importance on voluntary education for the same reason, compared to those with more time on the bench. Though there are obvious differences among the professions of judge, physician and soldier, a finding like this could nevertheless be applicable to the military setting. It may suggest that newer enlistees will more likely use their educational benefits in order to maintain competence and quality and that higher ranked enlistees may participate in voluntary education for other reasons.

Other Characteristics Associated with CE Participation

These studies, above, show that motivation, whether internalized or externalized, can explain a servicemember's reasons for participating in continuing education. Other research that attempts to understand or predict CE participation is, at least on the surface, less theory driven. In lieu of theoretical explanations to accurately specify models, analyses in the following studies tend to use standard demographic and personal characteristics to explain CE participation, with very little explanation of why those characteristics are included in the model. For example, Becerra (1983) suggested that women and minorities, have a greater tendency than white men to view the military as a vehicle for upward socioeconomic movement. As such, it makes sense to include race and sex in models explaining CE participation. As Boesel and Johnson (1988) note, "one would expect to see a tendency among women and minority members to take advantage of the educational opportunities afforded by TA [tuition assistance] as a means of upward mobility" (p. 11). Additionally, many of the studies that analyze the effects of participation in educational benefits on retention and performance look also at what factors predict participation in the first place. This is done, primarily, to control for selection bias. The result is that these studies lack clarification of why certain variables are included to explain CE participation. Clearly, more theory-driven research is needed to explain CE participation. Nevertheless, available research identifies certain characteristics that can help predict CE participation.

Several studies have shown that military service itself has had a positive effect on educational attainment for veterans (Binkin, Eitelberg, Schexnider, & Smith, 1982; Kolstad, 1986, Mason, 1970). Cohen, Segal, and Jemme (1986), found that the higher the rank one achieved in the military, the higher the level of education that was eventually achieved. But these results seem to be confounded by the fact that promotions are partly determined by educational level achieved. Others have found that when comparing educational attainment level of white servicemembers to their civilian counterparts, those in the military attained less education,[1] but this did not hold true for black and Hispanic servicemembers, who average much more education than their civilian contemporaries (Fredland & Little, 1984). Fredland and Little also found that white, black and Hispanic servicemembers had higher educational aspirations than their civilian contemporaries. In terms of motivation to participate in educational opportunities, many argue that people are attracted to the military primarily for the purpose of getting an education. Some servicemembers view their military service as one and the same with their educational aspirations (Kolstad, 1986). While this view may be widespread among servicemembers, researchers have also found that there are important intervening variables that influence educational attainment among servicemembers.

For example, Wright (1989) found that the mother's education, the father's occupation, high school grade point average, student aptitude, student high school program, and the individual's reason for entering the military were all individually significant predictors of a servicemember's educational attainment. When these factors are considered together, the two best predictors of the level of educational attainment of military enlistees were the mother's education and her educational aspirations for the enlistee. When comparing servicemembers with their civilian contemporaries, Wright found that there was very little difference in the factors that influenced educational attainment. The author suggested that the military should take these characteristics into account when utilizing educational incentives for enlistment or retention.

Brauchle (1998) derived interesting results by analyzing both short- and long-term participation in educational benefits as dependent variables.[2] For both measures of participation, women were more likely than men to participate, at a rate of 1.5:1. Single servicemembers were more likely to participate in the short term than married, but in the long term, married members were more likely to participate. Army and Air Force servicemembers are more likely to participate than sailors and Marines (this is probably due to shipboard deployments). However, Army members participated in short-term education at higher rates than Air Force members, and Air Force members were much more likely to participate in long-term education than Army enlistees. The results of this study should be interpreted carefully, because many of the

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[1] Fredland and Little (1984) note that "comparing educational levels of young servicemen with those of civilians of similar ages is biased if the data are truncated by age. If men under 22 are examined, members of the military clearly cannot have completed as much education as civilians who went directly from high school to college, and even to graduate school" (p. 212).

[2] Short-term participation assessed whether or not the person had attended a civilian college during the previous year. The long-term voluntary education variable was created based on survey responses to questions concerning education level at time of entry (into the military) and the education level possessed at the time the survey was completed. Long-term participation was defined as an increase in education level (from entry to the time of the survey), with the restriction that the individual had completed at least "some college."

variables—including long-term participation, reenlistment intentions, and marital status—are related to time in service.

Two other studies that analyze the characteristics associated with CE participation focus on Navy and Marine Corps officers. In terms of motivation for CE participation there is some convergence between officers and enlisted servicemembers (i.e., promotion potential, individual aspiration, etc.), however, there are important differences. In general, studies show that enlisted personnel are more likely to participate in TA programs. For example, Boesel and Johnson (1988) found that Army enlisted personnel are more than three times as likely to participate. This is most likely because officers incur further obligation to the military if they use CE benefits, whereas enlisted personnel do not. Additionally, officers tend to have college degrees already. Boesel and Johnson indicated that personnel with college degrees (whether enlisted or from the officer corps) participate in TA programs at much lower rates.

Fuchs (1996), in trying to predict which Naval officers choose fully-funded graduate education, found that those with better undergraduate records and with a more technical background were more likely to seek and be selected for graduate education. Fuchs found that married officers tended to pursue graduate education at higher rates. Additionally, those officers who were recommended to receive a promotion earlier than average (as an O1 or an O2), were more prone to seek graduate education. Wielsma (1996) conducted a very similar study focused on Marine Corps officers. He found that better performers and women were more likely to participate in graduate education than lower performers and men. He also found that commissioning source was a good predictor of graduate school participation. Naval Academy graduates were more likely to participate than those commissioned any other way.

Conclusion

One of the main findings here is that more theory development is needed to understand who participates in CE and why. Lack of theoretical understanding may not only lead to poorly specified models, but also to wrong conclusions. For example, Garcia, Joy, and Reese (1998) in their study of the Navy's Voluntary Education program, found that education program completion rates are lower for junior sailors compared to senior sailors. Consequently, the authors recommended that the Navy limit enrollment of junior sailors. Theory would suggest, though, that the program's value added to the Navy may be greater for junior enlisted (e.g., E1s and E2s) than for more senior enlisted (e.g., E3s and E4s). For example, consider two sailors in their first enlistment—an early career E1 and an E4 near the end of his or her enlistment. Given that both sailors have the same probability of reenlisting, the Navy would have a longer time period over which to recoup investment in the soldier who participates earlier in the program. Thus, while Garcia et al. found that limiting enrollment for junior soldiers may be the Navy's recommended course, theory suggests that the opposite may be true.

Table 1 depicts the characteristics and motivations of those who participate in CE programs, based on the literature reviewed in this section.

Table 1
Who Participates in Continuing Education and Why

	Characteristics Predicting CE participation	Motivations to participate in CE
From military studies	• Military service • Achieving higher rank • Race/ethnicity • Mother's education • Mother's educational aspirations for enlistee • High School GPA • Student aptitude • High School program • Individual's reason for entering military service • Sex • Marital status • Military branch • Level of contentment with military life • Promotion status • Military performance • Source of commission	• Military culture/norms • Opportunity to participate • Professional improvement/development • Personal development • Job security • Improvement of service to customers • Professional identity/perspective • Competence • Collegial interaction
From Civilian Studies	• Sex • Time in career	• Organizational norms • Enhance personal/professional position • Collegial interaction • Self-identity in their profession

Benefits of Continuing Education to the Military

The Department of Defense and the military Services have studied the effects and value of providing continuing education to both enlistees and officers. In general, this literature suggests that continuing education programs are of value to the services. Most of the empirical evaluations have been directed at three criteria: recruiting, performance, and turnover[3]. Although

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[3] It should be recognized, however, that these three criteria are likely to be highly interrelated, and could lead to spurious conclusions. For example, a significant relationship between CE participation and promotion may be largely explained by differences in retention – the longer you stay in the service the greater the chances of

the primary goal of this review is to determine the impact of ACES on job performance and turnover, we begin this section with a brief discussion of the potential impact of ACES on recruiting.

Recruiting

In numerous surveys, new recruits and soldiers have indicated that the provision of education benefits by the military was a major motivation for enlistment. The literature in recruiting and education benefits focuses almost exclusively on the recruiting effects of the MGIB and the ACF "kickers." Although we did not review this body of literature for this effort, numerous studies have found that education benefits improve recruiting – in terms of both the quantity and quality of recruits. As discussed previously, civilian sector studies note that one of the major reasons that employers provide CE programs for their employees is to improve recruiting.

Our search of the military literature did not produce any studies that looked at the impact of CE programs (for active duty servicemembers) on recruiting. The paucity of research in this area could be due to two factors. First, little information is available concerning whether potential recruits are aware of programs like ACES. That is, recruiters may be promoting programs like the G.I. Bill and ACF, but providing little information to potential recruits on education benefits available while on active duty. Second, there is no obvious source of data with which to conduct analysis linking CE programs to recruiting.

Performance

One of the stated goals of the ACES program is to improve the effectiveness of the force. Implicit in this goal is that participation in a CE program will enable a soldier to do his or her job more effectively. In this section of our review, we look at empirical investigations of the relationship between participation in CE and job performance. In particular, we report results from six studies that considered performance as a dependent variable. Descriptive information for each of the studies is presented in Table 2.

The table clearly shows the variety of independent variables evaluated in these studies. Of the five studies, for example, two looked at participation in tuition assistance programs, two looked at the attainment of graduate degrees, and one looked at enrollment in the Community College of the Air Force. The table also indicates variability in the operationalization of performance, with the most common operationalization being promotion. While performance and promotion could be considered as separate outcome variables, we believe that such a distinction would be artificial, and assume that promotion is a direct outcome of good performance. On the other hand, using promotion as a measure of performance may exaggerate its relationship with CE participation, because that participation is often used explicitly in

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promotion. We will provide reviews relevant to each of the criteria, and not attempt to address such mediated relationships.

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Table 2
Information on Studies Examining Promotion

Study	Service	Education Programs	Sample	Dependent Variable	Other Variables Controlled For
Alley, Mosley, Spivey, Bolton, & Mwambola (1995)	Air Force	Tuition Assistance	Enlisted, Officer	Ratings of how important CE programs are for performance and promotion	
Boesel & Johnson (1988)	All	Tuition Assistance	Enlisted, Officer	Promotion; Self-rated expectations of promotion	Armed Forces Qualification Test (AFQT) category*, enlistment period*, marital status, paygrade, race, sex, time in grade, time remaining in enlistment period*, total active federal military service
Fuchs (1996)	Navy	Graduate Education	Officer	Executive officer screen; Commanding officer screen; Promotion to O6	academic profile code, age at commissioning, commissioning source, early promotion, marital status, race/ethnicity, sex, technical preference in career field, type of undergraduate degree, utilization of graduate education at promotion board
Garcia et al. (1998)	Navy	Tuition Assistance, PACE, Academic Skills Learning Centers	Enlisted	Promotions, demotions	Education at accession, vacancies, % career on sea duty, AFQT score, age, sex, race/ethnicity, marital status, accession program, occupation
Niemiec (1987)	Air Force	CCAF	Enlisted	Early promotion vs. late promotion	
Wielsma (1996)	Marines	Graduate Degrees[A]	Officer	Average Performance Index; Promotion	Average performance index over career, age, sex, race, marital status, occupational community, general classification test score, composite ranking at the basic school, attendance at Naval Academy, enrollment in ROTC, participation in OTC

Notes: * indicates a variable that was used in the multivariate analysis of enlisted retention, but not officer retention. CCAF = Community College of the Air Force. [A] In this study, Marine Corps officers with graduate degrees were compared to officers without degrees.

making promotion decisions. Finally, the table indicates three of the studies carried out multivariate analyses, evaluating the relationship between participation in a CE program and performance while controlling for other explanatory variables.

The results of these studies indicate that participation in CE programs leads to better performance. Alley, Mosley, Spivey, Bolton, and Mwambola (1995) surveyed 1,687 Air Force officer and enlisted professional military education students regarding their opinions about the tuition assistance and off-duty education programs. Results indicated that 38% of respondents believed that the tuition assistance program improved officer job performance and 66% believed that the program improved enlisted performance (see Alley et al., [1995] Table 22). When asked more generally about advanced degrees, 24% of respondents indicated that officers with advanced degrees demonstrated better job performance than officers without such degrees. Similarly, 51% of respondents indicated that enlisted personnel with advanced degrees demonstrated better job performance than those without such degrees. When asked about promotion, 67% of respondents felt that having an advanced degree was an important factor in officer promotion, and 50% felt it was an important factor in enlisted promotion (see Alley, et al., [1995] Table 27). Interestingly, however, only 39% indicated that having an advanced degree should be considered as a major factor in officer and enlisted promotion decisions. Thus, there is a general perception that possessing an advanced degree *is* important for promotion, but less agreement that it *should* be considered for promotion.

Boesel and Johnson (1988) examined the relationship between participation in a tuition assistance program and promotion in a sample of 71,369 enlisted and officer personnel across three of the military Services. Of the sample, 10,718 had completed a tuition assistance course. Of the officers in the sample, 46.8% of those who had participated in a tuition assistance course indicated that that they were "Almost Sure" or "Certain" that they would be promoted, whereas 40.0% of officers who had not participated in such a course gave these responses.[4] These differences were even larger when the researchers investigated actual promotion records. In particular, Boesel and Johnson examined servicemember promotion records over an 18-month period. They found that 53.1% of servicemembers who had completed a tuition assistance course had been promoted whereas 39.1% of servicemembers who had *not* taken tuition assistance courses had been promoted in that time period,

To determine whether the differences in promotion could be attributable to factors other than participation in tuition assistance courses, Boesel and Johnson conducted multivariate analyses separately on enlisted and officer samples. The evaluation of the enlisted sample indicated that the relationship between tuition assistance participation and promotion was still strong after controlling for the effects of sex, race, marital status, AFQT score, education, paygrade, term of enlistment, time in grade, and time remaining in enlistment period. The multivariate analysis of officer promotion, however, indicated no relationship between participation in the tuition assistance program and promotion. That is, the univariate relationship between tuition assistance participation and promotion was fully accounted for by the other variables.

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[4] These data were obtained by matching the database to the 1985 DoD survey.

Niemiec (1987) examined the relationship between taking courses at the Community College of the Air Force (CCAF) and promotion. The sample consisted of 3,001 individuals who had been promoted to the rank of Master Sergeant. A median split technique was used to divide the sample into two groups, those who attained the rank early and those who attained the rank late. The results indicated a modest relationship between study at CCAF and promotion. In particular, 80% of the individuals who were promoted early had at least registered for courses at CCAF, whereas only 72% of the individuals who were promoted late had registered. In addition, 20.5% of the individuals promoted early had attained a degree, whereas only 9.9% of those promoted late had attained a degree.

Fuchs (1996) investigated the effects of participation in graduate education on the promotion of field grade Naval Officers. His sample consisted of 8,269 Naval officers, 1,218 who had participated in a graduate education program. The study shows, overall, that participation in fully-funded graduate education has a positive effect on three different officer career progression criteria, including (a) executive officer screening, (b) commanding officer screening, and (c) promotion to O-6. The effect of graduate education in all three types of promotions was significant and positive. In the executive officer screen, for example, officers with fully funded graduate education had a success rate of 69.5% whereas those without fully funded graduate education had a success rate of 47.7%.

Fuchs also found that officers who utilized their graduate education later in their career progressions had a greater chance for promotion than were those who used their graduate education at earlier promotion boards. Finally, officers who obtained non-technical graduate degrees were more likely to be promoted than were those officers who received technical graduate degrees. Fuchs speculates that this is because non-technical fields of study may be more relevant to senior management duties.

Research by Wielsma (1996) evaluated performance differences between Marine Corps officers with graduate degrees and those without graduate degrees. The sample consisted of 1,087 officers who entered the Marine Corps in fiscal year 1980, 78 of whom ultimately obtained a postgraduate education. A unique aspect of this study was the fact that it included a measure of on-the-job-performance, the average performance index. Marine officers are rated on a fitness report on an annual basis. The performance report, which includes ratings of 22 professional and personal characteristics, is scored in terms of three dimensions: performance, qualities, and overall value for the service. The average performance index score for each officer in the study was computed as the average score on the performance dimension across all of the ratings the individual had received in his or her career. Results indicated that those with graduate degrees had significantly higher scores on the average performance index than those without such degrees.

Wielsma also evaluated the promotion rates among those officers who stayed to the O-4 promotion point. Results indicated that while 79% of those with graduate education who had stayed to the promotion point were promoted, only 65% of the officers without graduate

education who had stayed were promoted. A multivariate analysis[5] indicated that graduate education was a strong, significant predictor of promotion in an initial model that did not include the performance index measure or general classification test score (a marker for cognitive ability). When these variables were added to the model, however, the magnitude of the graduate education variable was reduced, but it remained significant.

Summary of findings on performance. The studies reviewed in this section vary widely in terms of the samples used, the type of continuing education programs evaluated, and the ways in which they define performance. Despite this variability, however, these studies all generally indicate that continuing education programs have a positive effect on performance. Although reduced in magnitude, this effect appears to hold up in multivariate analyses that control for other potentially explanatory variables. The effect would also appear to hold for both officers and enlisted personnel.

Because most of the studies reviewed used promotion as a measure of performance, the results should be interpreted carefully because CE participation is factored into the promotion decision. A relationship between CE and promotion may merely reflect the fact that participation in civilian education can give a servicemember points that are counted in determining his or her eligibility for promotion. Most of the studies described in this review mention this artifact, but none of the studies use statistical techniques to isolate the impact of CE participation on promotions independent of the promotion points awarded for educational attainment.

Retention

Turnover is costly to the military. To replace a soldier who separates, the military incurs recruiting costs, training costs, and a loss of experience and skills. Furthermore, when soldiers separate, the military incurs permanent change in station (PCS) costs, administrative costs to outprocess the separating soldier, and lost productivity during the time the soldier is transitioning out of the military. Our review of the literature suggests that the ACES program may reduce turnover. Enlisted servicemembers leave the military for many reasons. For this study, we look at two broad categories of separations for enlisted personnel: (a) failure to **reenlist** and the end of a servicemember's term of service, and (b) **attrition** during a term of service (particularly the first term). We analyze these two retention outcomes separately because attrition and reenlistment outcomes typically occur at different stages of a soldier's career. In addition, the opportunity to participate in various CE programs changes throughout a soldier's career so the impact of participating in a specific CE programs may vary for the two retention outcomes.

Reenlistment. We identified seven relevant studies on the impact of CE programs on retention (Table 3). Two studies are of enlistment members only; two studies are of officers only; and three studies conduct separate analyses for both enlisted members and officers. The analyses of enlisted members use reenlistment outcomes as the outcome measure. The analyses of officers use overall retention as the outcome measure. Four of the studies looked explicitly at participation in tuition assistance programs; two looked at participation in graduate education;

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[5] Wielsma (1996) presented two types of multivariate analyses: PROBIT and ordinary least squares. Only the results from the PROBIT analyses are reviewed in this document.

Table 3
Information on Studies Examining Retention.

Study	Service	Education Programs	Sample	Dependent Variable	Other Variables Controlled For
Alley et al. (1995)	Air Force	Tuition Assistance	Enlisted, Officer	Rating of relationship of CE to retention and satisfaction	
Boesel & Johnson (1988)	All	Tuition Assistance	Enlisted, Officer	Intention to reenlist, reenlistment	AFQT category*, enlistment period*, marital status, paygrade, race, sex, time in grade, time remaining in enlistment period*, total active federal military service
Brauchle (1998)	All	Tuition Assistance	Enlisted, Officer	Intention to reenlist	race, spouse's satisfaction with his/her education, desire to participate in off-duty education in the previous year, education level at time of survey, current enlistment*, civilian job opportunity, job satisfaction, long-term education participation, short-term education participation, sex, marital status, satisfaction with military life, pay grade, spouse's satisfaction with military life, education level at entry, total active federal military service
Burtzman (1994)	Navy	FFGE	Officer	Annual retention rate	
Garcia et al. (1998)	Navy	Tuition Assistance, PACE, Academic Skills Learning Centers	Enlisted	Reenlistment	Education at accession, selective reenlistment bonus type, pay grade at decision point, scheduled for promotion, sea duty or next tour ashore, AFQT score, age, sex, race/ethnicity, number of dependents, marital status, unemployment rate, occupation
Simutis, Ward, Harman, Farr, & Kern (1988)	Army	BSEP	Enlisted	Retention rate, attrition rate	
Wielsma (1996).	Marines	Graduate Degrees[A]	Officer	Staying in service to O-4 promotion point	Average performance index over career, age, sex, race, marital status, occupational community, composite ranking at the basic school, attendance at Naval Academy, enrollment in ROTC, participation in OTC

Note: * indicates a variable that was used in the multivariate analysis of enlisted retention, but not officer retention.
FFGE = Fully-funded graduate education. BSEP = Basic Skills Education Program. [A] in this study Marine Corps officers with graduate degrees were compared to officers without degrees.

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and one focused on basic skills education. Four of the seven studies used multivariate regression analysis to isolate the impact of CE participation on retention while controlling for other explanatory variables that were hypothesized to affect retention.

In their survey of officer and enlisted professional military education students, Alley et al. (1995) asked several questions concerning the perceived influences of the tuition assistance program on retention. Results indicated that 65% of respondents agreed (rated the item as "Strongly Agree" or "Agree") that a major reason enlisted people stay in the military is because of the educational opportunities (compared to 10% that indicated "Disagree" or "Strongly Disagree"). The trend results were somewhat different for officers. That is, only 20% of respondents agreed that officers stay in the military because of the educational opportunities (compared to 33% who disagreed).

In terms of job satisfaction, which some argue is connected to retention, respondents felt that tuition assistance improved the job satisfaction of both officers and enlisted personnel. Specifically, 39% agreed that tuition assistance improved officer job satisfaction (11% disagreed), and 68% agreed that it improved enlisted satisfaction (6% disagreed).

Boesel and Johnson (1988) also examined the relationship between participation in a tuition assistance program and retention. Based on data from a 1985 DoD survey, they found that 13.4% of the people in their sample that had participated in tuition assistance planned on leaving the service at the end of their current commitment. In contrast, they found that 23.6% of people in their sample who had *not* participated in tuition assistance planned on leaving the service.

This difference was even more dramatic when actual retention was evaluated. Of the people who had participated in tuition assistance, 18.6% had left the military in the 18-month time period examined by Boesel and Johnson. The failure to reenlist rate was much higher (35.8%) among people who did not participate in TA. The strong significant relationship between participation in TA and retention was found among both enlisted and officer personnel even after controlling for the effects of other explanatory variables.

A study by Brauchle (1998) was designed as a replication and extension of the Boesel and Johnson (1988) study. Brauchle used data from a 1992 DoD survey to evaluate the relationship between ever having participated in CE and self-reported intention to reenlist. [6] The correlation between the CE participation measure and the intention to reenlist was found to be weak (accounting for only 3% of the variation in the intention to reenlist), but statistically significant. The results of multivariate analysis were similar; long-term participation continued to be a significant predictor of the intention to reenlist, but the amount of variance accounted for by this variable was relatively small.

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[6] This measure of CE participation was created based on survey responses to questions concerning education level at time of entry (into the military) and the education level possessed at the time the survey was completed. The participation measure was defined as an increase in education level (from entry to the time of the survey), with the restriction that the individual had completed at least "some college."

In an extension of the Boesel and Johnson (1988) analysis, Brauchle included additional measures in his multivariate analyses, including job satisfaction, satisfaction with the military way of life, and civilian employment prospects. He found that this more complex model explained almost 41% of reenlistment behavior compared to the replicated model that explained only 25%. The best predictor of reenlistment intention in the more complex model was satisfaction with military life, which explained 26% of reenlistment behavior. In this model, ever having participated in off-duty education accounted for just under 8% of the variation in intent to reenlist. Though off-duty education participation does not account for a large percentage of a person's reasons to reenlist, the author nevertheless concludes that retention rates are higher among those who do and who want to participate in off-duty education (even if they don't participate), controlling for education level.

Brauchle notes that members with longer service are both more likely to have participated in a CE program during their military career and are more likely to reenlist. Consequently, he assessed a short-term measure of participation in a CE program—i.e., having participated during the previous year. Brauchle reports a very small, but significant negative relationship between this variable and the intention to reenlist. He speculates that those who plan to leave the service take advantage of the opportunity to receive financial assistance and prepare for the civilian job market in greater numbers than do those who intend to remain in service. These results underscore the importance of examining as much of a servicemember's history as possible in evaluating the relationship between CE participation and reenlistment.

The primary focus of research conducted by Brutzman (1994) was toward an evaluation of the utilization, defined as serving a tour in a billet related to the subject area of the graduate education, of Navy officer personnel who received fully-funded graduate education (FFGE). While utilization is unrelated to the purposes of the present review, she also examined the relationship between FFGE and retention. Using a longitudinal database, she compared the percentage of FFGE officers who left the Navy to the percentage of non-FFGE officers who left the Navy for each of the years 1981 to 1993 (with the exception of 1983). This comparison indicated that the percentage of FFGE officers leaving the Navy was lower in every year. Across the years, an average of 4.8% of all FFGE officers left per year whereas an average of 11.2% of non-FFGE officers left. She also indicates that "73.1% of all FFGE officers remained in the service past their commitment" (p.53), which is a retention rate nearly double that in the non-FFGE groups.

In his comparison of Marine Corps officers with and without postgraduate education, Wielsma (1996) also considered the effects on retention. In this study, retention was defined as staying in the service to the O-4 promotion point. It was found officers choosing to stay in the Marines are more likely to have obtained a postgraduate education. Although only 7% (n = 78) of the sample had graduate degrees, 15% (n = 67) of the people who stayed to the O-4 promotion point had graduate degrees. Looking at this analysis differently, 83% of those with graduate education stayed to the O-4 point. This percentage stands in dramatic contrast to the 38% of those without graduate education who stayed. Wielsma also conducted a multivariate analysis to evaluate this effect. In this analysis, graduate education was a strong, significant predictor of retention in an initial model that did not include the performance index measure (the general classification test score variable was not included in this analysis). When the measure of on-the-

job performance was added to the model the magnitude of the graduate education variable was reduced, but it remained statistically significant.

Research by ARI (Simutis, Ward, Harman, Farr, & Kern, 1988) indicates that BSEP also increase retention rates. For example, they found that a sample of 3,271 BSEP graduates had lower attrition rates (3.4% vs. 34.6%) and higher reenlistment rates (37.9% vs. 11.0%) than a comparison group (n = 3,328).

The findings of this literature review support the hypothesis that CE programs improve retention. People who complete some form of CE program tend to stay in the services longer than those who do not. Multivariate analyses have also indicated significant positive relationships between CE participation and retention when other variables have been taken into account. The small number of studies on enlisted servicemembers and data and methodological problems with the studies we reviewed do not allow us to estimate the size of the impact on retention.

Attrition. Attrition is a subset of total separations and is an issue that pertains mainly to enlisted personnel in their first term of service. Although numerous studies have analyzed the causes of attrition in the military, to our knowledge the study by Simutus et al. (1988) described above is the only one that investigated the effect a CE program may have on reducing attrition. One reason for the paucity of research in this area may be that a large percentage of attrition occurs early in the initial enlistment. Consequently, many soldiers who separate early have not had the opportunity to become informed about, or participate in, the military's CE program. The BSEP program evaluated by Simutus et al. (1988) is one that is available to a soldier early in his or her career, and consequently would be more likely to reduce attrition.

In the remainder of this section we review the general literature on attrition to provide information on the data and methods used in previous studies to model attrition. Attrition can occur for numerous reasons, some of which are beyond the military's control. Consequently, it is useful to construct two working definitions of attrition—"voluntary" attrition and "involuntary" attrition. Voluntary attrition is defined as those separations that are the result of the soldier's actions (e.g., the decision to leave, poor performance or unacceptable behavior). Involuntary attrition is defined as those separations that are not the result of choice (e.g., death, and medical and psychological disability). While most reasons for separation can be classified unambiguously as either voluntary attrition or involuntary attrition, the classification is not straightforward, and may be arbitrary, in many cases.[7]

The main reason that an analysis should distinguish between voluntary and involuntary attrition is to build a causal model of the attrition process that can accurately capture the relationship between attrition and its explanatory variables. Previous research has shown that this

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[7] There is some concern whether the Army's separation data are sufficiently reliable to separate attrition into meaningful categories. For example, a soldier might receive a medical discharge when the true reason for separating was not medical related. To the extent possible, involuntary separations (e.g., death) that can be identified should be excluded from the analysis.

relationship differs by reason for separation (see, for example, Klein and Martin, 1991). Most research has focused on the issue of voluntary attrition.

Hogan, Smith and Sylwester (1991) conducted a study that investigates the impact of the ACF on both attrition and reenlistment. They found that supplemental education benefits have only a small, statistically nonsignificant effect on contract completion. Unlike the BSEP program, which is often used by soldiers early in their career, the ACF is primarily used by soldiers after they separate. Consequently, it is not surprising that Hogan et al. found a much smaller effect for that program than Simutus et al. (1988) did for BSEP.

Laurence, Naughton and Harris (1995) reviewed the attrition literature and discussed the known and suggested causes of first-term attrition. Below, we summarize the explanatory variables used in previous analyses of attrition.

- *Contract length.* Hogan (1979) shows that longer contract length is positively correlated with attrition. However, estimation of the magnitude of the theoretical relationship between contract length and the probability of separating prior to contract completion is complicated by the likelihood that soldiers with a higher taste for military life—and thus at lower risk of attrition—may be more likely to choose contracts of greater length.

- *Education (as measured by years completed, diploma, and GED).* Many studies have found that having a high school diploma is the best single predictor of completing the first-term enlistment. However, the reason why high school graduates are less likely than non-graduates to separate early is unclear.[8]

- *Mental ability.* Enlistees with higher AFQT scores are less likely to separate early than those with lower scores (see, for example, Flyer and Elster, 1983; Laurence, 1984, 1987; Klein and Martin, 1991). In addition, AFQT has been found to be a better predictor of attrition among high school graduates and for whites versus blacks (Elster and Flyer, 1982). In this analysis, average grade in high school provides an additional proxy for mental ability (although grades are a function of both ability and effort).

- *Military occupation and skills.* Past studies have found differences in attrition rates between occupational specialties in the military (e.g., Fernandez, 1985; Finstuen & Alley, 1983; and Rosenthal & Laurence, 1988). Reasons may be that some jobs are more arduous or onerous than others. Also, in some occupations soldiers are learning skills that are more marketable in the civilian workforce.

- *Race/ethnicity.* The literature shows mixed findings on the relationship between race/ethnicity and attrition. Cooke and Quester (1988) find that relative to members of

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[8] Plausible explanations are that ability and personal skills that contribute to a successful graduation are the same factors that contribute to the successful completion of one's enlistment contract. Consequently, a high school diploma not only represents a level of academic success, but also represents unobservable characteristics such as ability and degree of discipline. Laurence (1987) found that attrition rates of soldiers with a GED more closely resemble attrition rates of non-high school graduates than of graduates.

racial or ethnic minority groups, whites are more likely to be discharged for administrative reasons and less likely to be discharged for disciplinary actions. Klein and Martin (1991) find that all else being equal, white recruits are more likely than their black counterparts to separate early both for medical and adverse reasons.

- *Sex.* Various studies have found that women are more likely to separate early than men (e.g., Flyer and Elster, 1983). Compared to men, women are more likely to separate for medical reasons (often for pregnancy) and less likely to separate for disciplinary-related actions.

- *Supplemental education benefits.* Hogan, Smith and Sylwester (1991) find that supplemental educational benefits offered under the Army College Fund have a small, negative effect on attrition. However, they find that the relationship is not statistically different from zero.

- *Age.* Past studies have shown that the relationship between age and attrition is not especially strong, although there is some evidence that younger soldiers are more likely than their older counterparts to separate because of behavioral problems and older soldiers are more likely than younger soldiers to separate for medical reasons.

- *Marital status and number of dependents.* Both marital status and number of dependents can vary across soldiers and over time. Past studies are fairly consistent in finding that married soldiers are more likely to separate early than single soldiers, although the relationship may be weak (Klein and Martin, 1991). This pattern holds for both male and female soldiers. Little research has been conducted to determine whether attrition is correlated with having dependents or with the number of dependents.

- *Economic conditions.* The ratio of military to civilian pay and the unemployment rate are two possible explanatory variables to control for economic conditions. Kleinman and Zuhoski (1980) estimate the effect of pay and other determinants on Navy pilot attrition. They find that pilot attrition increases as the pay of civilian pilots increases relative to military pay.

Many of the studies we reviewed model the interaction of the explanatory variables described above. For example, Klein and Martin model the interaction of race and AFQT score, and the interaction of race/ethnicity and age.

Methodological Issues and Data Limitations

The empirical studies that we reviewed encountered numerous methodological issues and data limitations that are relevant to this study. Failure to address these issues could potentially reduce the reliability of the findings and add bias to the evaluation. As discussed previously, individuals who participate in employer-sponsored education and training programs are chosen either through self-selection, or by the employer. There is no random assignment. Furthermore, many of the same factors—such as ability and motivation—that help determine program participation also influence the job performance and retention outcomes that we desire to analyze. To obtain unbiased estimates of the impact of CE program participation on the

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outcomes of interest, one must construct an experimental design that controls for the non-random nature of selection for program participation.

Isolating the value added by CE program participation is made difficult by the confounding relationship between the outcomes of interest (i.e., recruiting, performance, and retention) and the attributes of individuals in the sample. Methodological issues and data limitations further complicate the analysis. In this section we describe the methodological and data issues encountered in the empirical literature. We give a brief description of the each issue and describe the techniques used in past studies to address these issues. These issues are (a) evaluation design and selection bias, (b) data limitations, and (c) sampling issues.

Evaluation Design and Selection Bias

The studies we reviewed all use a retrospective evaluation design where the education programs were evaluated using historical data and where the evaluator had little or no input into the process by which individuals were selected to participate in the education program evaluated. The optimal experimental design, in terms of obtaining unbiased findings, would be a "controlled" experiment in which members of the relevant population (e.g., soldiers) were randomly assigned to a test group (e.g., individuals eligible to participate in the CE program) or to a control group (e.g., individuals not eligible to participate). Then, data on the outcome of interest (i.e., recruiting, performance, and retention) would be collected over time to determine if there are systematic and significant differences in the outcomes of individuals in the test and control groups.

Because virtually every soldier is eligible to participate in the major CE programs under ACES and because participation in the CE programs reviewed is voluntary, such an ideal "experiment" is not possible. Controlling for the voluntary nature of program participation is vital to isolating the CE programs' impact on the outcomes of interest. For example, Fuchs (1996) found that Naval officers with a stronger academic background and more favorable performance ratings early in their career were more likely to pursue a graduate education and had a higher probability of promotion to commander.

Because a controlled experiment with random assignment generally is not feasible, researchers have used "quasi-experimental" evaluation designs to mitigate the effect of selection bias. A quasi-experimental design controls for factors that affect both assignment to the test group (i.e., CE program participation) and the outcomes being analyzed. The two main approaches to conduct a quasi-experimental design are multivariate regression analysis and matched-pairs analysis. The empirical studies that we reviewed use the former approach exclusively.

Wielsma (1996) used a multivariate regression analysis to determine how attending graduate school affects performance and retention of USMC officers. Talaga (1994) estimated three regression models to determine the impact of graduate education on three measures of performance for naval surface warfare officers. Fuchs (1996) estimated a regression model to analyze the impact of participating in a graduate education program on the promotion of Naval officers. Garcia et al. (1998) estimated a series of regression models to determine how participation in the Navy's Voluntary Education (VOLED) program affected promotions and

retention of sailors. Boesel and Johnson (1988) used the regression model approach to determine how participation in a DoD Tuition Assistance program affected retention in the military and promotions of enlisted soldiers. The empirical rigor of these studies and the ability to generalize their findings to ACES varies from study to study, but the literature suggests that the evaluation of some ACES programs, particularly TA and FAST, will find a modest, positive effect of ACES program participation on soldier retention and promotions.[9] However, the effects of many ACES programs, such as MOS improvement training and NCO leadership training, have not been assessed by previous evaluations.

The purpose of using a multivariate regression is to isolate the effect of each explanatory variable on the dependent variable. Because ACES participation is voluntary, and because many of the factors that determine program participation are also predictors of performance and retention, the estimates from the regression model may be biased unless one controls for self-selection. Several approaches have been suggested in the literature to mitigate the problem of selection bias. These approaches are not necessarily mutually exclusive.

The first approach is to estimate a regression model that contains all observable soldier characteristics that help determine program participation (i.e., control variables) and explanatory variables that affect the outcome of interest.[10] Inclusion of the control variables help minimize the problem of "selection" bias, while inclusion of the explanatory variables help minimize the problem of "omitted" variable bias. Factors such as pay, bonuses, and MOS that may affect the outcomes of interest should be included in the regression analysis. Even though these factors may be uncorrelated with program participation, including them in the model will reduce the residual variance and thus increase the precision of the estimated program effect. To the extent that one can successfully include the variables that are correlated with participation and that also affect retention and promotions, one will obtain an unbiased estimate of the program effect, using participation as the "treatment" indicator. However, if one omits some variables that are correlated with participation and that affect outcomes, the estimated program effect may still suffer from selection bias.

The second approach requires that two regression models be estimated. This approach is sometimes referred to as the "Heckman two-step procedure." The first step is to estimate a probit model to predict the probability of program participation. This probability is manipulated to form a ratio, known as the "Inverse Mills Ratio," that is used as a control variable in the second regression. The second regression contains all the explanatory variables hypothesized to affect the dependent variable, in addition to the Inverse Mills Ratio. This approach was used by Boesel and Johnson (1988), Garcia et al. (1998), and Wielsma (1996).

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[9] Although the retention effect is likely to be small, even a small increase in retention may translate into large dollar savings to the Army in terms of reduced recruiting and training costs.

[10] In the econometrics literature on program evaluation, this is sometimes called "selection on observables" in that observable, measurable factors affecting both participation and outcomes are explicitly controlled for by including them in the multivariate estimation equation.

Boesel and Johnson (1988) estimated a probit model of participating in a TA program. Then, the authors estimated a logit model to determine the relationship between remaining in the military during the period July 1986 to December 1987 and independent variables—including the Inverse Mills ratio. They also developed a similar model to estimate the relationship between promotions during the period July 1986 to December 1987 and these independent variables.[11]

Garcia et al. (1998) used the Heckman two-step procedure to control for voluntary participation in the Navy's VOLED program in their study of the impact of VOLED participation on reenlistment and promotions of Navy enlisted sailors. The authors estimated logit models to predict retention and promotion as a function of VOLED program participation and various sailor attributes. Wielsma (1996) used the Heckman procedure to control for selection bias in his study of the effects of graduate education on promotions of USMC officers.

A third approach to control for selection bias is useful if there are repeated observations on the "outcome" for the individual soldier, but variation over time in the soldier's participation. In this case, the soldier serves as his or her own "control" and one examines changes in outcomes before and after program participation. One example is when enlisted naval personnel not qualified for A-school retake the AFQT in an attempt to qualify for A-school. None of the studies that we reviewed use this approach.

A fourth approach is to examine ACES program history to determine whether there is variation over time in when a program is offered or in access to programs. These would potentially constitute "natural experiments." Program effects would be measured based not necessarily on actual participation, but on the opportunity to participate. The measured impact would be the impact of the program on the soldiers who had access to the program compared to soldiers who did not, after controlling for other differences between the two groups that may potentially affect outcomes. Because the individual's actual choice to participate or not is not used as the treatment indicator, potential self-selection bias is reduced. None of the studies that we reviewed use this approach.

An alternative to the multivariate regression approach to design a quasi-experimental evaluation is a matched-pairs analysis. For this approach, the researcher first identifies a sample of individuals who participated in the program and thus self-selected into the test group. To form a control group, the researcher identifies a "match" for each individual in the test group using the attributes of the individual to make the match. A major problem with this approach is that matching is difficult, and an inaccurate matching scheme will lead to inaccurate results.

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[11] One can make several criticisms of this study by Boesel and Johnson. First, the authors pooled data on soldiers of different grades and different enlistments instead of, for example, estimating different regression models for soldiers in their first, second, or third enlistment. The relationship between the independent variables (e.g., TA participation) and retention likely are very different for soldiers in their first enlistment versus soldiers in their second or third enlistment. Second, the authors used a continuous variable for pay grade. Thus, the relationship between grade and the probability of remaining in the military was assumed to be constant over all grades (e.g., E-1 versus E-2, and E-2 versus E-3, etc.). The same criticism holds for the analysis of promotions. Third, the authors did not consider whether a soldier's enlistment ended during the July 1986 to December 1987 time period. Consequently, the model likely overpredicts the probability of remaining in the Services. Whether this misspecification biased the coefficients on the independent variables is unknown.

What factors have been shown to affect the propensity of soldiers to participate in a voluntary education program and also are hypothesized to affect retention and job performance? As discussed previously, Boesel and Johnson (1988) found that AFQT score, level of education, race, sex, and rank all were correlated with TA program participation. In particular, the soldier is more likely to participate in the TA program if the soldier has a higher AFQT score, has a higher level of education (up to having a college degree), is black, is female, and is a sergeant (E5 through E7).

Garcia et al. (1998) found that the probability of participating in the Navy's VOLED program was statistically higher if the sailor was female; Hispanic or Asian Pacific Islander; and was in an administration, aviation supply, or medical career. The participation probability decreased with sailor age at time of accession, if the sailor had been demoted, and percent of career on sea duty. Talaga (1994) estimated a model to predict enrollment in the Navy's postgraduate school. Positive and statistically significant predictors of program participation included various measures of academic ability (i.e., undergraduate grade point average and a measure of math skills performance), measures of job performance (i.e., recommendation for early promotion, qualification for Surface Warfare or Engineering Officer of the Watch before the O-3 promotion board, or qualification for Tactical Action Officer), and number of curricula for which the officer was eligible.

Data Limitations

The studies we reviewed encountered several data limitations that are relevant to an evaluation of the ACES program. These issues are sample attrition, censoring, and measurement error.

Sample Attrition. Sample attrition occurs when members leave the sample before the end of the data collection period. Failure to control for sample attrition may bias the findings. Below we provide a brief description of the issue as discussed in the literature.

Consider the following example that illustrates how sample attrition may affect the evaluation of ACES. Suppose one wishes to design an evaluation of the effect of CE program participation on promotions. The researcher will collect information on a sample of soldiers who participate in the program (i.e., the test group) and soldiers who did not participate in the program (i.e., the control group). Then, the researcher will determine if soldiers in the test group were more likely to be promoted during a given period of time (e.g., within two years after participating in the education program). Some soldiers, however, may leave the military before the end of the data collection period. Thus, one never observes whether the soldier was promoted. If the reason for leaving is related either to participation in the CE program or to the outcome of interest, then sample attrition may bias the findings.

In this example, if a soldier thinks he or she will likely be promoted, then the soldier may decide to reenlist. Alternatively, if the soldier thinks he or she will not be promoted, then the soldier may decide not to reenlist. If ACES participation increases the likelihood of promotion, then failure to control for this sample attrition would cause one to overestimate the impact of ACES on promotions. In this hypothetical scenario, soldiers who do not participate in ACES have a lower probability of promotion and are thus more likely to leave the sample through

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attrition. If soldiers who left the sample through attrition are dropped from the analysis, then the estimated ACES program effect could be biased high. Counting the soldiers who left the sample through attrition as "not promoted" would also bias the findings.

Censored data. The problem of censored data is a general problem that includes sample attrition as a special case. Censoring occurs when an event of interest (e.g., participation in a CE program, promotion, or reenlistment) cannot be observed, either because it occurs outside the period over which the data are obtained, or because other events make this variable impossible to detect. This concept is relevant to the evaluation of ACES because complete data on ACES participation is unavailable prior to 1999. Thus an evaluation of ACES programs would be affected by "left" censoring, which occurs when the event takes place prior to the observation period. "Right" censoring occurs when the event happens after the observation period. Sample attrition can be viewed as an example of censoring in which the censoring event occurs during the observation period.

Measurement Error. Measurement error occurs when precise measures of a particular variable of interest may not be available. This may occur because no physical measure corresponding to the variable of interest is available (e.g., intelligence or experience), or because the variable is not measured consistently. The bias introduced by measurement error can be severe (Green, 1997). Four sources of measurement error were evident in the studies we reviewed.

The first source of measurement error is associated with CE program participation. Measurement error in this variable can occur for many reasons—including poor records of members' CE program participation. If members who participated in a CE program are recorded as non-participants, either because of poor data recording or censoring, then the effect is to attenuate (or bias towards zero) the measured ACES effect on the dependent variable. A previous study of ACES (Brink, Newman, Spurgeon, & Stock, 1981) found missing ACES participation data to be a common phenomenon.

The second source of measurement error is associated with the measure of retention. Studies of employee turnover in the civilian literature note the problem of measurement bias in measuring turnover—both when using survey data and when using administrative data (Griffeth and Hom, 1995). At issue is how a separation is categorized. In general, evaluations of retention are interested in determining what factors can decrease voluntary turnover. Thus, these studies often omit involuntary separations (e.g., employees who are fired or who leave for death or medical reasons). Some survey respondents may not accurately categorize their separation as voluntary. That is, they may give more socially desirable reasons for quitting than do their employers. Likewise, reasons for separation in administrative databases may not be completely accurate. For example, a person who separated involuntarily (e.g., fired) may be categorized as a voluntary separation (e.g., laid off) to make the separate employee eligible for unemployment compensation, or to avoid the possibility of litigation. The military literature that we reviewed did not investigate why people leave.

Job performance measures represent a third source of measurement error. As discussed previously, measures of job performance are not readily available for soldiers. Furthermore, measures of job performance will vary by the type of work soldiers perform—which can differ

substantially across soldiers. Consequently, the studies we reviewed that analyze the impact of CE participation on job performance use promotions (and in some cases demotions) as a proxy for performance. Although promotions generally are indicators of good performance, there are numerous factors other than performance that are determinants of promotions. Some of these variables are observable and can be controlled for in a regression model (e.g., time in grade, MOS). Other factors are less observable to the researcher (e.g., number of promotion positions available). The main issue, though, is that because promotions are an imprecise measure of performance, studies of the impact of CE participation on promotions does not capture the "true" relationship between CE participation and job performance.

Finally, measures of cognitive ability/intellect represent a fourth source of measurement error. Soldiers' ability and intelligence are important determinants in the propensity to participate in a CE program and the likelihood of promotion. Researchers have used different variables as proxies for ability and intelligence. For example, the most common measures include AFQT score (e.g., Garcia et al., 1998; Boesel & Johnson, 1988), high school diploma (e.g., Garcia et al., 1998), early promotion or special qualification by a review board (e.g., Fuchs, 1996; Talaga, 1994), and grade point average (e.g., Fuchs, 1996; Talaga, 1994). These variables are only proxies for ability and intelligence, so the "true" relationship between ability/intelligence and the dependent variable of interest is unknown and the estimated relationship is biased towards zero—or no effect (Green, 1997). Unfortunately, a poorly measured variable can bias (in unknown directions) the estimates for other explanatory variables in the multivariate regression model. Although including a variable measured with error in the regression model reduces the reliability of the estimated relationship between CE program participation and the outcome of interest, omitting the variable could cause a worse problem.

Sampling Issues

Two sampling issues addressed in the literature that are relevant to this study are sampling error and sample sources.

Sampling Error. Most of the military studies that we reviewed were based on relatively large samples. For example, Boesel and Johnson's (1988) study of DoD's Tuition Assistance program was based on nearly 100,000 members of the military. However, when one desires to analyze subsets of the sample, sampling error becomes an increasingly important issue. For example, when Boesel and Johnson analyzed only those members in the Navy who had participated in the TA program and who responded in the survey that they were "almost sure" or "certain" of promotion, then the sample size dropped to approximately 84. In general, larger samples result in more precise estimates of the impact of CE participation on the outcome of interest. That is, one is more confident of findings that are based on larger samples than findings based on smaller samples.

Sample sources. The primary source of information for the military studies we reviewed was administrative databases. In general, the authors of the studies merged administrative records on CE program participation with a "master" file that contained information on soldiers' career history. The master file used in the analysis typically contained information on the

soldiers' demographic characteristics, job characteristics, and the outcome of interest (e.g., promotion or retention) for a cohort of soldiers.[12]

One of the main limitations of administrative data is that vital information on soldiers' unobservable attributes (e.g., intentions, perceptions, and satisfaction) is not available. As a result, the findings of various studies are clouded by factors that the researchers cannot control. Boesel and Johnson, in their study of DoD's Tuition Assistance program, had the unique opportunity to merge administrative records with the 1985 DoD Survey. This allowed the authors to compare the outcomes of interest (i.e., reenlistment and promotion), by TA participation status, stratified by how survey respondents answered various questions in the survey. They found, for example, that soldiers who had never participated in a TA program were intending to leave the military at higher rates than soldiers who had previously participated in a TA program. Their findings are likely biased, however, for failing to control for factors that are correlated with both participation in a TA program and intention to remain in the military—such as time in service.

Summary and Implications

The research literature provides limited coverage of CE programs, focusing primarily on tuition assistance and basic skills programs. Within this limited range, the research gives a relatively positive picture of the effects of participation in these programs on retention and performance. This section summarizes the research findings, describes some of the limitations of these findings, and makes recommendations for the evaluation of ACES based on these results.

Summary of Findings

The literature provides a fairly consistent picture of both the motivations to take part in CE and effects of CE on recruitment, retention, and performance. Despite differences between military and civilian employment environments, the conclusions of research in these two areas are consistent.

Continuing education serves both organizational and personal goals. A program such as ACES provides an opportunity for a soldier to improve performance on his or her military mission and to better prepare for later civilian employment. Given the divergent goals that may be served by CE, it is not surprising that the motivations for participation are complex and include both internal and external factors. Despite the divergence in motivations, it seems to be a fair characterization of the situation that those who participate in CE tend to be better qualified and more highly motivated soldiers (or employees) than those who don't. This difference confirms our concern that the evaluation plan must control for selection bias.

Although there is little direct evidence that opportunities for CE enhance recruitment, circumstantial evidence would suggest that they do. Overall, educational benefits are a principal reason for enlisting. Although the G.I. Bill and the ACF are the most well publicized educational

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[12] A cohort is typically defined by when soldiers entered the military or were eligible for a specific event (e.g., reenlistment or promotion), or by military rank.

benefits, CE seems likely to be a contributing factor. The importance of educational benefits in private industry would also suggest that they have a positive effect on recruitment, since private industry has no program that is analogous to veterans' benefits.

A positive effect of CE on performance is reflected in the opinions of officers and enlisted personnel, promotion rates, and actual performance ratings. Servicemembers indicated that they believed that CE would improve job performance, particularly for enlisted personnel. Although there is little data to judge whether these perceptions are accurate, the effect of participation in CE on promotion was positive, even after controlling for the effects of moderating variables. In correspondence with servicemember opinions, the effects on promotion rates were stronger for enlisted personnel.

Turnover covers both retention and attrition. Regarding retention, existing research paints a clear picture in which consistent participation in CE (particularly tuition assistance) increases the likelihood that servicemembers will reenlist. The effect remains, albeit at a reduced magnitude, when effects of other factors are controlled statistically. There are some exceptions to the general finding, such as the Brauchle's (1998) result indicating that servicemembers who intend to separate from military service also participate in tuition assistance, perhaps to prepare for their civilian career.

We found limited evidence that basic skills education may reduce attrition substantially, but no research that examines the effect of other CE programs on attrition. Because basic skills education can occur early in a soldier's career, it has the potential to affect attrition, most of which also occurs early. We suspect that other programs, such as tuition assistance would not have a substantial effect on attrition, which tends to occur before the soldier has had much opportunity to use tuition assistance.

Limitations of Results

Several factors limit the generality of the findings of past research. First, with few exceptions, the existing research evaluates voluntary, postsecondary education programs, most notably TA. Although some of the relationships that were found for TA programs were confirmed for the BSEP program, no research was found addressing other ACES programs, or their counterparts in either the other Military Services or the civilian workplace.

Taken as a whole, the results reaffirm the importance of considering selection bias in evaluating the effects of CE programs. Available evidence indicates that the individuals who participate in CE programs tend to be better qualified and more highly motivated than those who don't. Consequently, effects of CE participation on retention or performance are reduced when attempts are made to control for selection bias. Results of studies in which selection bias was not controlled for should be viewed with caution. The simplest presentation of results, in this case, may be misleading.

One limitation of several studies reviewed is that the authors combined data on servicemembers in different stages of their military career instead of estimating different models for different types of members. Assuming that the relationship between CE participation and the outcome of interest is fixed across all types of service members could bias the findings. For

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example, the motivation for participating in a CE program may be much different for a soldier in his or her first enlistment term than in his second enlistment term. Consequently, the relationship between the dependent variable (e.g., retention) and the explanatory variables (including CE participation) may be different for the different types of members. An analysis of the retention effects of CE participation for members in their first enlistment could have significantly different findings than an analysis of the retention effects of CE participation for members in their second enlistment.

The existing studies were not guided by an overall conceptual modeling framework. Such a framework can guide the selection and operational definition of outcome and control variables.

Recommendations for the Evaluation

For the most part, the outcome measures addressed in previous research, retention and promotions, are reasonable to include in an evaluation of most ACES programs. They are important to the Army, and previous research has shown that educational benefits can affect these outcomes. To the extent that other performance measures can be identified in existing personnel databases, they should be addressed as well. Improvements in these more direct measures of performance would not be confounded by interactions with other variables, such as time in service. Evaluation of the effects of CE on attrition should focus on programs, such as FAST, that occur early in a soldier's career.

The need to control for selection bias has been stressed several times in this review. We believe that the process of controlling for selection bias would be aided by using a general model of the retention or promotion process to guide the data analysis, including the identification and selection of control variables. In other words, the analysis needs to consider more than simply whether a soldier participated in ACES and a single control variable (e.g., the Inverse Mills Ratio). A more general model of retention or promotion is required, that includes additional explanatory variables not necessarily related to ACES participation. The use of such a model would also aid the interpretation of results, as well as in forecasting the results of policy changes.

Several other sources of bias should be considered in the evaluation design and analysis plan. Limits of the data—sample attrition, censoring, measurement error, and sampling error—should be considered for the variables selected for inclusion in the evaluation. The sample size and analytical methods should be devised to minimize the effects of these errors.

EVALUATION PLAN

Because ACES participation is voluntary and available to all soldiers, it is not possible to design a controlled experiment in which a randomly determined subset of soldiers are eligible to participate in the program. One major implication of evaluating a program without random assignment to a test and control group is that soldiers who participate in the program could be systematically different from soldiers who do not participate. Furthermore, many of the factors that increase the propensity of soldiers to participate in ACES (e.g., motivation and ability) are likely to affect the outcomes of interest (i.e., retention and job performance). Thus, the evaluator must identify which differences in outcomes between the test and control groups should be attributed to ACES, and which differences should be attributed to underlying differences between participants and non-participants.

This evaluation plan draws from the results reported in the literature reviewed in the previous section. It also considers constraints brought about by the availability, accuracy, and completeness of data indicating program participation and critical outcome variables reflecting soldier retention and performance. The literature review identified explanatory variables that should be collected for the evaluation and recommended methodological approaches and statistical techniques that should be used to conduct the evaluation. Following this section, the database development plan provides a detailed discussion of what variables should be included in the evaluation database and how that database should be constructed. The database development plan and the evaluation plan are closely linked. A major purpose of the evaluation plan is to help guide the data collection process. Similarly, data availability, as documented in the database development plan, affects how the evaluation can be conducted.

Purpose of the Evaluation Plan

Informed policy decisions require a comprehensive and technically sound evaluation of the ACES program and the benefits it provides to the Army and its members. The main purpose of this evaluation plan is to assure a successful evaluation by identifying (a) questions that the evaluation should answer, (b) data that should be collected to answer these questions, (c) a technical approach to analyze the data, and (d) statistical and data issues that the evaluation must address.

This evaluation plan is built on a solid theoretical foundation and several decades of applied research on the topics of Army manpower planning, program evaluation, and the benefits of education and training. The methods and models proposed in this plan build on the applied research conducted during the past two decades in the areas of staff retention, performance, and evaluation of education and training programs.

In summary, an evaluation plan helps assure a systematic evaluation of the data using structurally sound and complete models and appropriate modeling techniques. A thorough evaluation increases the likelihood that the study will provide policy-relevant and scientifically sound information regarding the contribution of ACES to Army readiness.

Evaluation Questions

The central issue for this evaluation is to determine the impact of the ACES program on combat readiness.[13] The hypothesis is that ACES improves combat readiness indirectly, through effects on recruiting, retention, and performance. The U.S. Total Army Personnel Command (PERSCOM) has requested that the evaluation focus on the two latter issues. The evaluation plan, therefore, is designed around the following questions:

1. What effect does ACES have on soldier retention, as reflected by such outcomes as early attrition and likelihood of reenlistment?

2. What effect does ACES have on soldier performance, as indicated by the likelihood and timing of promotions and Military Occupational Specialty (MOS) reclassification actions?

3. What is the net benefit, or value added, of ACES to the Total Army?

These three questions generate numerous other questions regarding the characteristics of soldiers who participate in the ACES program, whether the program benefits vary by type of soldier, the most probable timing of soldier participation in ACES, and whether certain ACES programs are more cost effective in terms of their contribution to combat readiness. Below is a more detailed list of questions that the evaluation should attempt to answer.

Soldier retention analysis.

1. Does the ACES program increase the propensity of soldiers to reenlist? If so,

   - Does ACES participation increase reenlistments at the end of the first term, second term, and additional terms?

   - Which ACES programs increase or decrease the propensity of soldiers to reenlist?

   - By how much does participation in specific ACES programs increase or decrease the propensity of soldiers to reenlist?

   - Does the ACES reenlistment effect differ by type of soldier (e.g., high school graduates versus non-graduates, soldiers with different career intentions) or by job attributes (e.g., by MOS)?

2. Does ACES decrease attrition? If so,

   - By how much does ACES decrease early attrition?

   - Which ACES programs decrease attrition?

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[13] This evaluation focuses on the costs and benefits of ACES to the Army, although participation in continuing education also has important implications for the soldier, for his or her family, and for society.

- Does any decrease in attrition differ by type of soldier (e.g., high school graduates versus non-graduates, soldiers with different career intentions) or by job attributes (e.g., by MOS)?

Soldier performance analysis.

3. Does participation in ACES programs increase job performance as measured by the occurrence and timing of promotions, and by reclassification actions? If so,

- Does ACES participation increase the likelihood that a soldier will be promoted?

- Does ACES participation reduce the expected time to promotion?

- Which ACES programs are best able to increase the likelihood or decrease the expected time to promotion?

- Does ACES participation increase the likelihood that a soldier will be reclassified to another MOS to further his or her career?

- Which ACES programs are most likely to lead to MOS reclassification?

- Does the impact of ACES participation on promotions differ by type of soldier (e.g., high school graduates versus non-graduates) or by rank?

Cost-benefit analysis.

4. What is the net value of ACES to the Army in terms of a cost-benefit analysis?

- What is the net present value of various ACES programs?

- Which ACES programs are most valued by the members?

- How does the cost per reenlistment attributed to the ACES program compare to the cost per reenlistment attributed to other programs (e.g., selected reenlistment bonuses)?

Outline of the Evaluation Plan

The remainder of this plan discusses the data and methods proposed to answer the questions posed above. The next section covers the scope of the evaluation. It considers which ACES programs to evaluate, the time period that will be covered in the evaluation, and the outcomes that will be explicitly defined and evaluated. Following that section is an overview of the most appropriate modeling techniques to conduct the evaluation. Then the evaluation plans for the retention and job performance analyses are presented in two sections. Each of these sections addresses the following three concepts:

1. The development of a conceptual model to identify particular hypotheses to be tested concerning the contribution of ACES to Army readiness;

2. The identification of an appropriate functional form, statistical techniques, and data to estimate the contribution of ACES to Army readiness; and

3. The identification of appropriate statistical tests to evaluate the model and its components and to test hypotheses regarding the effect of ACES on measures of Army readiness.

Following these two plans is a discussion of the data and methods to conduct a cost-benefit analysis of ACES. Approaches to quantify the benefits and costs, in dollars, are discussed. The final section contains a brief summary of the plan.

Scope of the Evaluation

ACES provides a wide range of programs and services to support the needs of the Army and to support the professional and personal development of soldiers in the area of education. ACES programs vary in terms of their resources, number of participants, and perceived importance of their contribution to Army readiness. Likewise, different ACES programs and services are designed to benefit soldiers at different stages in their military career.

This section contains a brief overview of ACES programs and discusses four criteria used to select those programs for which empirical evaluation is most relevant, viable, and cost effective. In addition, measures of ACES participation, measures of the contribution of ACES to Army readiness, and the time period over which to evaluate ACES are discussed.

ACES Programs and Criteria Used to Select Programs for Evaluation

ACES comprises several programs and services. Five of these programs meet the criteria to be included in an empirical evaluation: (a) the Army Tuition Assistance (TA) Program, (b) the Servicemembers Opportunity Colleges Army Degree (SOCAD) Program, (c) the Functional Academic Skills Training (FAST) program, (d) the MOS Improvement Courses, and (e) Non-commissioned Officer (NCO) Leader Development Courses.[14] The following criteria were used to select these five programs for evaluation.[15] Many of these criteria are inter-related.

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[14] These programs and services are similar to components of the Navy's VOLED Program included in a recent evaluation conducted by the Center For Naval Analysis (Garcia, Joy and Reese, 1998). Components of VOLED evaluated by CNA study include: (a) tuition assistance (with the same funding criteria as ACES), (b) the Program for Afloat College Education (PACE), (c) Academic Skills Learning Centers, and (d) Counseling.

[15] An evaluation of ACES conducted two decades ago (Brink et al., 1981) was designed to determine the effects of ACES program participation on soldier performance. That study proposed to evaluate four ACES programs that existed at that time: (a) Basic Skills Education Program I, Literacy Phase (BSEP I-Lit); (b) Basic Skills Program I, English as a Second Language (BSEP I-ESL); (c) Skill Development: General Vocational-Technical (Vo-Tech); and (d) Veterans Educational Assistance Program (VEAP). These four components were selected by the research team and the government's contract representatives based on eight criteria: (a) number of participants, (b) adequate size of participant and non-participant groups, (c) available and accurate participant data, (d) operational indicator of program completion or degree of participation in the program, (e) probable impact on military proficiency, (f) probable impact on Army career progression, (g) ease of data collection, and (h) perceived significance to the Army.

- **Level of funding**. Level of funding is an important criterion for two reasons. First, programs with more funding would be expected to have a larger impact on Army readiness than programs with less funding, so the impact is likely to be easier to detect. Second, to some degree, programs with more funding are likely to be more vital to the Army's mission.

- **Number of participants**. Programs with a large number of participants were more likely to be selected for evaluation than programs with fewer participants for several reasons. First, the accuracy of the estimated program effect increases with the sample size (or number of participants). Second, programs with a large number of participants are more likely to have a detectable impact on Army readiness.

- **Evaluability of the program**. For the evaluation to be effective, there must be (a) an adequate sample size for both the participant and non-participant groups, (b) a logical link between program participation and the soldier outcomes of interest, and (c) sufficient impact for the effect to be detectable.

- **Data availability**. Reliable data on program participation is required to evaluate a program. The three main sources of program participation data are the Education Management Information System (EDMIS), the Army/American Council on Education Registry Transcript System (AARTS), and databases of SOCAD agreements for two- and four-year degrees. In addition, the 1999 Survey of Active Duty Personnel (SADP) includes self-reported participation in several continuing education (CE) programs. These data sources are described in greater detail in the database development plan.

A brief description of 11 ACES programs and a comparison of these programs using three of the four criteria described above is provided in Table 4 (level of funding was excluded from the table). In addition, the table identifies those ACES programs that are "operational" in nature. Operational programs are those designed to benefit the military directly, although the member might benefit indirectly, while non-operational programs mainly benefit the member but might indirectly benefit the military.[16] Participation and cost estimates for all programs except SOCAD are taken from the ACES Quarterly Participation, Cost, and Evaluation Report for Fiscal Year (FY) 1999.

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[16] For example, MOS improvement courses offered through ACES are designed primarily to improve the member's job performance. For many college courses funded in part through Tuition Assistance, however, the member is likely the primary beneficiary with the Army benefiting indirectly.

Table 4
Application of Criteria to Determine Which ACES Components to Evaluate

ACES Programs	Description	Include in evaluation?	Program Selection Criteria			
			Program is operational in nature	Number of Participants (FY 99)	Evaluability of the Program	Participation Data Available
The Army Tuition Assistance Program (TA)	TA helps soldiers finance their continuing education at community colleges and universities during off-duty hours. Under this program, the Army pays 75% of tuition costs, up to $187.50 per semester hour, with a reimbursement limit of $3,500 per year. TA is available throughout the career, but participation is higher during the second term of service or later.	Yes	No	116,813 soldiers for 208,540 enrollments	Possibly a detectable effect on promotion, reclassification, and retention	Available in EDMIS
Service-members Opportunity Colleges Army Degree (SOCAD) Program	SOCAD is the Army's college degree program. Approximately 110 colleges participate in the program to provide approximately 30 curriculum majors at the associate and bachelor's degree level to soldiers worldwide. A soldier typically takes two courses at a school before signing a SOCAD agreement with that school.	Yes	No	17,281 new agreements in FY 99 reported by SOC	May be difficult to isolate effect from that of TA	SOCAD agreements available from SOC; Courses at SOCAD schools in EDMIS
The Functional Academic Skills Training (FAST) Program.	FAST provides soldiers with instruction to enhance basic skills necessary for job proficiency and career progression. FAST is designed to build academic competence of soldiers in three core areas: math, reading, and writing. Army recruits who score in Categories IIIB to IV on the Armed Forces Qualification Test (AFQT) are eligible for participation in FAST and typically participate early in their first term of service.	Yes	No	19,319 soldiers	Possibly a detectable effect on promotions, early reclassification, and retention	Available in EDMIS
Military Occupational Specialty (MOS) Improvement Courses	ACES provides opportunities for soldiers to improve proficiency in selected Military Occupational Specialties. Participants are primarily in their first term of service.	Yes	Yes	22,165 soldiers	Possibly a detectable effect on promotions and retention	Available in EDMIS

Table 4
Application of Criteria to Determine Which ACES Components to Evaluate

ACES Programs	Description	Include in evaluation?	Program is operational in nature	Number of Participants (FY 99)	Program Selection Criteria	
					Evaluability of the Program	Participation Data Available
NCO Leader Development Courses	Non-commissioned officers (NCOs) can attend leadership development courses. These courses are an important part of the NCO's career development for producing effective leadership.	Yes	Yes	25,038 soldiers	Possibly a detectable effect on promotions, reclassification, and retention	Available in EDMIS
ACES Testing Program: Civilian/ Academic Testing	The Civilian/Academic Testing Program provides administration of post-secondary tests and credit by examination. For some ranks, soldiers can earn promotion points with successful completion of certain tests.	No	No	199,084 soldiers took educational tests	Possibly a detectable effect on promotions, reclassification, and retention	Available in AARTS only for tests with passing grades
ACES Testing Program: Army Personnel Testing Program (APTP)	The APTP provides diagnostic testing to assess training needs, eligibility for specialized training, and personnel selection and classification.	No	Yes	67,798 soldiers took Army aptitude tests	Possibly a detectable effect on promotions, reclassification, and retention	Available in AARTS only for tests with passing grades
High School Completion	The programs helps soldiers without a high school or General Equivalency Diploma (GED) complete the GED requirements.	No	No	128 soldiers	Small participation rate precludes evaluation	Available in EDMIS
The English as a Second Language (ESL) Program.	ESL provides an opportunity to non-native speaking soldiers to receive formal instruction to increase proficiency in the English language.	No	No	46 soldiers	Small participation rate precludes evaluation	Available in EDMIS
Foreign Language Training Program	ACES provides training and testing for soldiers who wish to maintain proficiency in a foreign language.	No	Yes	18,680 soldiers	Benefits primarily related to soldier's mission	Available in EDMIS

Table 4

Application of Criteria to Determine Which ACES Components to Evaluate

ACES Programs	Description	Include in evaluation?	Program is operational in nature	Program Selection Criteria		
				Number of Participants (FY 99)	Evaluability of the Program	Participation Data Available
Counseling	Counselors located at installation Learning Centers coordinate soldier participation in ACES programs and help soldiers develop an education plan.	No	No	864,211 individual sessions; 238,501 soldiers in 8,711 group sessions	Small non-participant population, reason for counseling not available.	Available in EDMIS, but reasons for counseling unavailable
Army Education Centers	A total of 138 Education Centers are available at installations to provide soldiers with access to multi-media computers, the Internet, cable and video teleconferencing, classrooms, and testing facilities to facilitate the continuing education process.	No	No	1.5 million visits by soldiers	Difficult to assess benefits for this support program.	Available in EDMIS, but may not be maintained at all sites.

Programs were excluded from the evaluation for one or more of three reasons: (a) insufficient number of participants or non-participants, (b) unavailability or inaccuracy of participation data, and (c) impact on retention or performance expected to be limited in scope. For two of the programs, the High School Completion and the English as a Second Language (ESL) Programs, the participation rate was considered to be too low to obtain a reasonably sized sample of participants for evaluation. Counseling, on the other hand, had a very large number of participants, which would lead to a small non-participant population. In addition, the information we received from PERSCOM indicated that available participation data in EDMIS do not reliably record whether counseling was conducted for educational purposes or for some other reason. Similar potential data problems were brought up for Army Education Centers. Participation in the ACES Testing Program, which consists of Civilian/Academic Testing and Army Personnel Testing, is recorded in AARTS, but only for tests that are passed. This program was excluded because the participation data would give a biased view of the benefits of the program. The Foreign Language Training Program primarily serves the immediate, mission-related needs of soldiers who are stationed overseas, and was not expected to have any substantial long-term effect on retention or performance.

Outcome Measures Evaluated

The purpose of this evaluation, as discussed above, is to determine the impact of ACES on Army readiness. This evaluation focuses on two ways that ACES participation is hypothesized to affect Army readiness: (a) by improving staffing through lower early attrition and higher retention, and (b) by improving job performance (as measured by promotion and reclassification). As noted previously, "operational" programs such as the MOS Improvement Courses and the NCO Leader Development Courses are designed primarily to improve job performance, while non-operational programs such as Testing, FAST, Tuition Assistance, and Counseling provide soldiers with more general skills that indirectly benefit the Army (see Figure 1). Also, soldiers who perform better in their job are more likely to be promoted, and higher pay resulting from the promotion might increase the probability of reenlistment.

Retention. Two measures of soldier retention can be evaluated: (a) reenlistments at the first, second, or greater reenlistment decision; and (b) early first-term attrition. Because the vast majority of attrition occurs in the first term, there is little to be gained from looking at attrition in later enlistment terms. Reenlistment can be modeled as a dichotomous outcome: reenlisted versus did not reenlist.[17] To complete this analysis, one must identify several groups of soldiers: (a) soldiers who reached a reenlistment decision point, (b) soldiers at a reenlistment point who chose to reenlist, and (c) soldiers who chose not to reenlist. In addition, to analyze early attrition, one must identify which soldiers separated during the period for which data are collected and the reason for separation. (Appendix A contains a list of separation codes used to distinguish attrition from the decision not to reenlist). These groups are described in the following discussion.

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[17] Soldiers may also extend their current enlistment contract. Although it seems clear that extensions of a few months should not be included with reenlistments, it may be appropriate to consider longer extensions, such as those of one year or more, as being equivalent to reenlistments.
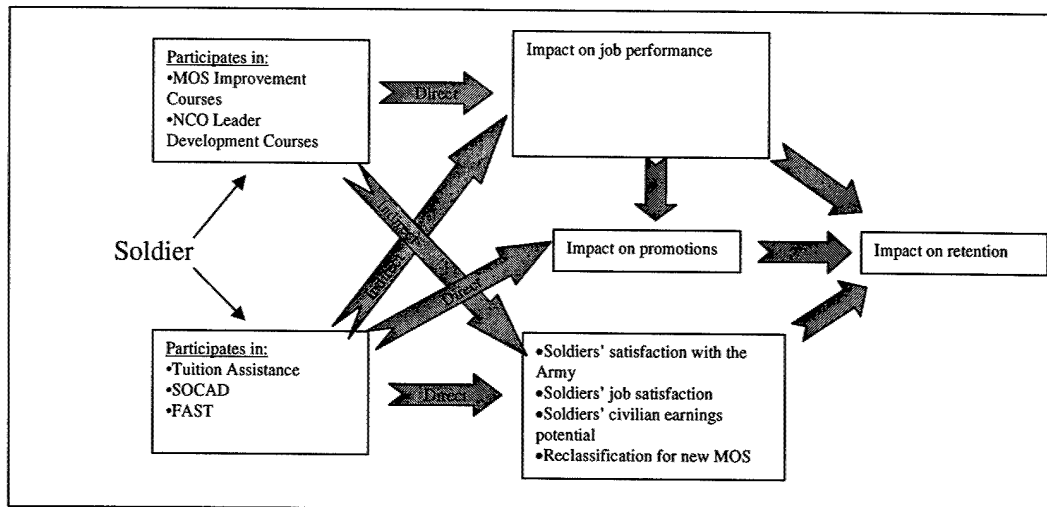
Figure 1. Model of program benefits.

- **Soldiers at a reenlistment decision point**. This group is defined as those soldiers who did not separate prior to completing their enlistment contract and who were not ineligible to reenlist because of medical or psychological reasons. Soldiers ineligible to reenlist for disciplinary reasons or for not meeting other requirements within the soldiers' control (e.g., failure to obtain a GED for soldiers enlisted without a high school diploma or GED) are included in this group.

- **Soldier who chose to reenlist**. Soldiers who reenlist at, or prior to, the expiration of term of service (ETS) date of their current enlistment contract are considered reenlistments.

- **Soldiers who "voluntarily" separate during the data collection period**. This category includes soldiers who separate for non-medical reasons during the data collection period. It is important to distinguish between "voluntary" attrition, defined as separations that are the result of the soldier's actions (e.g., the decision to leave, poor performance or unacceptable behavior), from "involuntary" attrition, separations for medical or psychological reasons. As discussed previously, there are some concerns regarding the ability of the Army's separation data to separate attrition into meaningful categories. To the extent possible, though, involuntary separations that can be identified should be excluded from the attrition analysis.

Performance. Little information on job performance is systematically collected and stored by the Army. Measures that are collected typically are not comprehensive, but deal with specific requirements (e.g., marksmanship, level of physical fitness) or pertain to specific military occupational specialties (e.g., scores on proficiency tests). For this reason, researchers often use promotions, and especially early promotions, as an indicator of superior performance. Promotions, though, are imprecise measures of job performance because factors other than performance, such as time requirements and the availability of promotion slots, affect promotions.

The evaluation should focus on promotions to E-5 and E-6 for several reasons. Because promotions through E-4 are largely automatic based on time in service, and because relatively

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few soldiers participate in most ACES programs (with the exception of FAST) in the early stages of their military career (e.g., as E-1s and E-2s), there is a reduced chance of finding an effect of ACES participation on promotions to grades lower than E-5. On the other hand, there are fewer NCOs at higher grades (E-7 and above) than at the more junior levels, reducing the sample size. Furthermore, promotions at the higher levels depend on the number of available positions, which, in turn, varies significantly with career field and other variables that are not related to performance. Consequently, these higher grades also have lower prospects of exhibiting positive effects of ACES participation.

Reclassification to another MOS can also be an indicator of performance. Some MOS changes may be coincident with promotions, but others may occur if a soldier becomes qualified for a more desirable MOS or an MOS with better promotion prospects. Past research has not examined whether participation in CE increases the likelihood of reclassifications, but as the conceptual model in Figure 1 indicates, there is some reason to anticipate that participation in some programs might have a positive effect on the likelihood of MOS reclassification.

Sources of outcome data. A primary source of administrative data on retention and performance that will be used for the evaluation is the Active Duty Military Personnel Edit File (PEF). The Defense Enrollment Eligibility Reporting System (DEERS) database contains additional relevant administrative information regarding the benefits for which soldiers are eligible (such as the Montgomery GI Bill [MGIB]). In addition, ARI has developed an extensive database on the FY 1999 accession cohort, called Project First-Term, which we propose to use for the attrition analysis. Finally, the 1999 SADP asks respondents questions regarding their intentions to remain in the military, as well as other satisfaction questions. A detailed description of the databases used and the rationale for their selection is included in the database development plan presented in the following section.

Period of Analysis and Cohorts

Data availability and the stages in a soldier's military career when the soldier might participate in ACES both affect the period and the cohorts chosen for the analysis. Data from EDMIS are available for all installations from 1999 forward, and from a subset of continental United States (CONUS) installations from 1995 forward. Ideally, historical data on soldiers' participation in ACES from accession to separation would be available for the evaluation. The goal for completion of the evaluation, however, limits the time frame for collecting data through approximately the end of the 2001 calendar year (CY). Consequently, for a subset of the Army there could potentially be seven years' data on ACES participation, while for the entire Army there would at most be three years' data on ACES participation (i.e., CY 1999 through CY 2001).[18]

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[18] To increase the time period over which ACES participation data are available, a cohort that consists of the subset of soldiers assigned to a CONUS installation that used EDMIS prior to 1998 was considered. For example, the evaluation could analyze a cohort that consists of soldiers who (a) were stationed to one of the 30 CONUS installations using EDMIS in 1996, and (b) were subsequently never assigned to an installation without EDMIS. One serious problem with such a cohort is that the sample would be non-random. It would over-represent soldiers

Soldiers might participate in different ACES programs at different stages in their military career. For example, participants in FAST tend to be relatively recent accessions, while participants in NCO leadership programs are NCOs (or soldiers who will soon be promoted to NCO). Consequently, participation in programs like Tuition Assistance and NCO leadership enhancement will likely be low during first enlistment, while participation in FAST will likely be much higher during the first enlistment than in subsequent enlistments.[19]

Given these data constraints and the nature of when soldiers typically participate in ACES, the evaluation focuses on the following five basic cohorts.

- **Cohort 1: Non-prior Service Accessions in FY 1999**. This cohort consists of all active duty, enlisted, non-prior service accessions in 1999. This cohort will be the focus of the analysis of early first-term attrition; it will also be used to examine effects of ACES participation on early reclassification. The primary ACES programs that will be examined in this cohort are FAST and MOS Improvement Courses, because these two programs are expected to be used by soldiers early in their first term of enlistment. The database used to define this cohort will come primarily from the ARI Project First Term attrition database and EDMIS.

- **Cohort 2a: Soldiers with an ETS date in CY 2001**. This cohort consists of all active duty, enlisted members with an ETS date in 2001. This cohort includes soldiers in their first, second, or greater term of enlistment. Although a complete history of ACES participation will not be available for some soldiers, a complete history of ACES participation in the two to three years prior to the ETS date would be available. The main purpose of analyzing this cohort is to determine the impact of ACES on retention— especially retention of soldiers in their second enlistment. Merging data from EDMIS, SOC, and PEF will provide the data describing this cohort.

- **Cohort 3a: Soldiers promoted to E-4 in 1998**. This cohort consists of all active duty soldiers promoted to E-4 in 1998. The primary purpose of analyzing this cohort is to determine whether ACES participation affects the occurrence and timing of promotions to E-5 (through 2001). Merging data from EDMIS, AARTS, and PEF will create the database describing this cohort.

- **Cohort 4a: Soldiers promoted to E-5 in 1998**. This cohort consists of all active duty soldiers promoted to E-5 in 1998. The primary purpose of analyzing this cohort is to determine whether ACES participation affects the occurrence and timing of promotions to E-6 (through 2001). One potential problem with this analysis is that ACES

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assigned to CONUS, it would likely over-represent soldiers in a small number of military occupations, and it would over-represent soldiers assigned to large installations.

[19] A study of DoD's Tuition Assistance program (Boesel and Johnson, 1988) found that TA program participation rates peaked at the E-5 and E-6 level. At the time the data were collected for this study, however, the TA program paid for 90% of tuition costs for soldiers in grades E-5 through E-9, but only 75% of tuition costs for soldiers below grade E-5.

participation is practically a requirement for promotion to E-6.[20] Consequently, the measure of ACES participation needs to be more than a dichotomous variable indicating that the soldier has participated. Recommended measures include the number of credit hours of college courses completed and award of a two- or four-year postsecondary degree. Merging data from EDMIS, AARTS, and PEF will create the database for this cohort.

- **Cohort 5: Soldiers in the 1999 SADP**. This cohort consists of all active duty, enlisted Army members who participated in the 1999 SADP. The primary purpose of analyzing this cohort is to determine whether participation in the tuition assistance program or other rated educational programs increased the propensity to reenlist as indicated by the survey respondents' intentions to reenlist.

The 1999 SADP cohort can be intersected with three of the other four cohorts to produce additional cohorts of interest. We do not recommend intersecting the SADP with Cohort 1, because there is already a rich set of attitudinal data collected for this cohort. Use of these intersected cohorts allows the analyst to consider other explanatory variables (e.g., satisfaction measures) that are included in the survey but not in administrative data sources. Whether these cohorts provide useful information will depend substantially on their size. The SADP data include approximately 25,000 observations from Army enlisted personnel and officers; the intersection of this cohort with the other cohorts will have substantially fewer observations. The following cohorts are obtained by the intersections of Cohort 5 with each of the other cohorts:

- **Cohort 2b: Soldiers in both Cohort 2a and Cohort 5**.

- **Cohort 3b: Soldiers in both Cohort 3a and Cohort 5**.

- **Cohort 4b: Soldiers in both Cohort 4a and Cohort 5**.

Analysis of these cohorts would allow one to measure the impact of ACES on early first-term attrition (Cohort 1), soldier reenlistment (Cohorts 2a, 2b, and 5), promotions to E-5 (Cohort 3a and 3b) and to E-6 (Cohort 4a and 4b), and reclassification (Cohort 1, 3a, 3b, 4a, and 4b) (see Table 5).

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[20] Army Regulation 600-8-19 (Enlisted Promotions and Reductions) states that 10 promotion points are awarded for completion of one of the following education improvements while on active duty: (a) obtains a high school diploma or GED, or (b) completes any postsecondary course or test. Furthermore, if recommended for SSG [E-6], the soldier must have completed one of the actions in grade SGT [E-5].

Table 5
Analysis Cohorts, ACES Participation, and Possible Impacts on Army Readiness

Cohort	ACES Programs Analyzed					Army Readiness Outcome Measures
	Tuition Assistance	SOCAD	FAST	MOS Improvement Courses	NCO Leader Development Courses	
Cohort 1: Accessions in 1999						• Early attrition • Early reclassification
Cohorts 2a and 2b: Soldiers with an ETS date in 2001 • First enlistment • Second enlistment • Third or greater enlistment						• First, second, and third plus reenlistment decision
Cohorts 3a and 3b: Soldiers promoted to E-4 in 1998						• Whether promoted to E-5 • Time to promotion to E-5 • Reclassification
Cohorts 4a and 4b: Soldiers promoted to E-5 in 1998						• Whether promoted to E-6 • Time to promotion to E-6 • Reclassification
Cohort 5: Soldiers in the 1999 SADP						• Intention to reenlist at first or later reenlistment decision

Overview of the Methodological Approach and Data Issues

The purpose of this section is to provide a brief overview of the proposed approach for the evaluation and to introduce several methodological and data issues that the evaluation must address. This overview will provide the reader with a framework for better understanding the proposed methods and models described in more detail in the following three sections.

Methodological Approach

Multivariate regression techniques can help isolate and quantify the impact of ACES on soldier retention and job performance while controlling for other factors that potentially affect retention and performance.[21] The techniques proposed here are consistent with those used in the literature, although in many aspects this evaluation will be more rigorous than earlier studies of Department of Defense (DoD) voluntary education programs.[22] Multivariate regression uses data on individual soldiers to model the occurrence of an event based on the soldiers' attributes, job characteristics, and participation in an ACES program.

The choice of regression technique depends on the nature of the dependent variable, or outcome measure, of interest. To study retention, one can analyze the soldiers' decision whether to stay in the Army (i.e., reenlistment decisions) and the timing of a separation (i.e., early first-term attrition). Studies in the military literature on the effects of voluntary education programs on job performance use promotions and timing of promotions as indicators of superior performance. All of the outcomes of interest (i.e., reenlistment, attrition, reclassification, and promotion) are dichotomous, although some outcomes incorporate a time factor. Logistic regression (or probit analysis) and survival analysis[23] are the most appropriate techniques for estimating the impact of ACES on soldier retention and job performance.

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[21] An alternative to the multivariate regression approach is a "matched-pairs" analysis in which soldiers who participate in ACES are "matched" to soldiers who do not participate in ACES. The matching process uses observable soldier attributes to identify a counterpart for every soldier in the sample who participated in ACES. Magnum, Magnum and Hanson (1990) evaluated several studies on worker training that used matched-group comparisons. They concluded that the results are highly sensitive to the degree to which accurate matching occurs (p. 80). Both a regression analysis and a Matched-pairs analysis can be used to control for member characteristics and job characteristics that have been hypothesized to affect the dependent variable. The techniques should produce similar findings.

[22] The general approach for the retention analysis will follow the approaches used by Hogan and Smith (1991) to study the affects of the Army College Fund on soldier attrition and retention and by Garcia et al. (1998) to evaluate the retention effects of the Navy's VOLED program. The general approach for the promotion analysis will follow the approach used by Garcia et al. to evaluate the effects of VOLED on the performance of sailors in the Navy.

[23] Other names for survival analysis include "hazard rate analysis," "event history analysis," "duration analysis," and "transition analysis."

Logistic regression is used to model the occurrence of a dichotomous outcome (e.g., reenlists versus does not reenlist, or promoted versus not promoted) as a function of certain explanatory variables.[24] (An alternative to logistic regression is a probit analysis, although both modeling techniques should result in similar findings).

In survival analysis, the key variable of interest is the length of time until a certain event occurs—e.g., separation or promotion. In survival analysis, a "spell" refers to the length of time until the occurrence of the event. For example, to study early first-term attrition, the spell would be the length of time between accession and separation (for those who separate early) or between accession and either contract completion or the end of the data collection period. To study promotions from, say, E4 to E5, the start date would be the date promoted to E4 and the end date would be the date promoted to E5 (for those promoted) or either the separation date or the end of data collection period (for those not promoted). Thus, the spell is defined as the length of time between promotion from E4 to E5, or the length of time from E4 to when the observation is censored (i.e., the soldiers' separation date or the end of the analysis period).

Each spell is represented by a number T, which has a distribution over time (t) and is a function of the hypothesized or observed explanatory variables that affect T.[25] One statistical

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[24] The logit form equation to predict the event (E) as a function of explanatory variables (X) and parameters (β) is expressed:

$$\text{Prob}(E=1|X) = \frac{1}{1+e^{-(\beta_0+\sum_{k=1}^{K}\beta_k x_k)}},$$

$$\text{where } E = \begin{cases} 1 \text{ if event occurred, and} \\ 0 \text{ if event did not occur} \end{cases}$$

[25] Suppose that T has a continuous probability distribution $f(t)$ where t is the realization of T. The cumulative probability (for a given soldier) that the event occurs is:

$$F(t) = \int_{s=0}^{t} f(s)ds = \text{Prob}(T \leq t)$$

The probability that a spell is at least t in length is given by the survival function:

$$S(t) = 1\text{-}F(t) = \text{Prob}(T > t).$$

Given that the event has not occurred prior to time t, one is interested in the probability that the event will occur during the next time period (Δ). This can be expressed mathematically as:

$$A(t,\Delta)=\text{Prob}(t \leq T < t+\Delta | t \leq T).$$

The likelihood that the event occurs during Δ, as Δ becomes infinitely small, is the instantaneous rate of occurrence, which is called the hazard rate. The hazard rate can be expressed in terms of the probability distribution and the survival function:

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issue that can be addressed by survival analysis is data censoring. Some individuals might leave the sample before the event of interest occurs, and failure to address censoring might lead to incorrect findings. For example, in an analysis of promotions, some soldiers will separate from the military prior to being promoted. Censoring is discussed in more detail below.

Data and Methodological Issues

Several data and methodological issues increase the complexity of the evaluation and its ability to provide precise and unbiased estimates of the retention and job performance benefits of ACES participation. One issue is that soldiers who participate in ACES (i.e., the "test" group) are not a random sample drawn from the population of soldiers. Some soldier attributes that influence the soldier's propensity to participate in ACES might also influence soldier retention and job performance. A second issue is censoring, when either ACES participation or the retention or promotion outcome of interest occurs outside the period over which soldiers are observed. A third issue is the handling of missing data. A fourth issue is measurement error. A fifth issue, which is relevant to an analysis of early first-term attrition, is unobserved heterogeneity.

Non-random Assignment/Self-Selection. The ideal experimental design to evaluate ACES, as discussed previously, would be a controlled experiment where soldiers were randomly assigned to a test group that was eligible to participate in ACES or to a control group that was not eligible to participate in ACES. Then, each group would be observed over time to determine if the retention behavior and job performance of the two groups differed systematically. Random assignment to a test and control group is not possible for this evaluation, however, as is the case for many studies of human behavior.[26]

The methodological problem that arises because of non-random participation in ACES is that many soldier attributes (e.g., motivation and ability) that increase the propensity to participate in ACES likely are correlated with retention and job performance. Similarly, some

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$$h(t) = \frac{f(t)}{S(t)},$$

which generally is preferable to model than either the probability distribution or the survival function. Three distributions of T that are common in survival analysis are the exponential, Gompertz, and Weibull distributions. The models that use these distributions are known as the exponential, Gompertz, and Weibull models, respectively, and are members of the general class known as proportional hazards models. The exponential model assumes that the hazard is constant over time—i.e., $h_i(t)=\lambda_0$, while the Gompertz and Weibull allow for the hazard to vary with time. When T follows a Gompertz or a Weibull distribution the hazard functions are expressed, respectively, $h(t) = \exp(\mu+\alpha t)$ and $h(t) = \exp(\mu+\alpha \log t)$.

[26] Non-random assignment to certain military occupations might also bias the findings. For example, if recruits at higher risk of attrition (e.g., non-high school graduates) are more likely to be assigned to an MOS with lower training costs, then the model might erroneously attribute some of the attrition causality to MOS. Likewise, promotion opportunities at higher ranks will vary by MOS. One method to determine whether non-random assignment to an MOS potentially biases the findings is to is determine whether explanatory variables that predict the outcome of interest are also correlated with the choice of MOS. A correlation analysis will be completed as part of the evaluation.

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soldiers might participate in ACES because they plan to stay in the military. Unless one controls for sample selection, the impact of ACES on reenlistment, attrition, reclassification, and promotion might be overestimated.

Many of the characteristics that affect the decision to participate in ACES are unobservable to the evaluator. That is, there is unobserved "heterogeneity," or differences, between the test and control group. Thus, it is difficult to determine what differences in outcomes between the test and control groups should be attributed to ACES and what differences in outcomes should be attributed to unobserved heterogeneity. As was stated previously, there are four approaches that can be used, either alone or in combination, to mitigate the problem of selectivity bias in the estimation of the program impact.

- The first approach is to control statistically for all observable soldier characteristics that might correlate with either program participation or the outcome of interest by including them in the relevant estimation equations.

- A second approach is to construct an "instrumental variable" for program participation to indicate the treatment effect, rather than actual participation. To do this, at least one variable or factor must be found that affects program participation, but does not directly affect outcomes. If, for example, some assignments (e.g., Korea) make it more difficult to participate in ACES but do not affect retention or promotions, then an assignment variable might serve as an instrumental variable. Intuitively, instead of actual participation, one would use predicted participation, where predicted participation is based on the correlation of actual participation and the instrument—in this example, an indicator of assignment. Needless to say, the difficulty with this method is discovering a valid "instrument"—the variable correlated with ACES participation but uncorrelated with outcomes.

One variation of the instrumental variable approach is a technique known as the "Heckman two-step procedure". Using this technique, the researcher can calculate a measure known as the "Inverse Mills Ratio" that is used to control for unobservable characteristics that affect both ACES participation and the outcome of interest. Garcia et al (1998) used the Heckman two-step approach to control for self-selection to evaluate the impact of the Navy's Voluntary Education (VOLED) Program on retention and promotions. Talaga (1994) used this approach to evaluate the impact of the Navy's fully funded graduate education program on Surface Warfare officer promotions.

The first step in this technique is to fit a probit model to estimate the effect of ACES participation determinants (Z) on the decision to participate in ACES.[27] The second step

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[27] The probit model is specified:

$$\text{Prob}(ACES = 1 \mid Z) = \int_{Z\beta}^{\infty} d\phi(z),$$

is to estimate a model that predicts the dependent variable as a function of its explanatory variables. For example, a logit model could be estimated to predict reenlistment (R) as a function of its determinants (X) and ACES participation (A) while controlling for ACES self-selection via including the Inverse Mills Ratio (I) as a control variable in the regression.[28]

Table 6 lists explanatory variables contained in the selected data sources that could be used in the first step of the Heckman procedure (i.e., the probit analysis) to predict ACES participation. Most of the variables described in Table 6 came from the literature review and were reported in Table 1. Others elaborate on these variables. For example, past research shows marital status to be a factor in predicting CE participation. Table 6 includes marital status in addition to two related variables: (a) whether the soldier has a military spouse and (b) the number of dependents. Other variables, such as access to ACES programs, were not addressed in previous research. These were selected based on a review of the available data sources. For example, one item in the SADP asked whether the soldier had another job during off-duty time. Since such a job would severely restrict that soldier's access to ACES programs, this variable would likely predict ACES participation.

- A third approach is to estimate a "fixed-effects" model in which the soldier serves as his or her own "control." For this approach, the outcome measure (e.g., performance) for each soldier is examined both before and after ACES program participation. This approach is of limited use for this evaluation, though, because it requires repeated observations of the outcome of interest, and no standardized measure of job performance is available with repeated observations. Also, this approach does not apply to an analysis of retention.

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where $ACES = 1$ if the soldier participated in ACES, and 0 if the soldier did not participate in ACES. In addition, β is a vector of parameters to be estimated. The Inverse Mills Ratio (I) is calculated from the normal probability distribution function, $\phi(\hat{\theta}Z_i)$, and the normal cumulative density function, $\Phi(\hat{\theta}Z_i)$ of this probit model:

$$I_i = \frac{\phi(\hat{\theta}Z_i)}{\Phi(\hat{\theta}Z_i)}.$$

[28] This logit model is expressed:

$$\text{Prob}(R = 1 \mid X, I) = \frac{1}{1 + e^{-(\beta_0 + \sum_{k=1}^{K} \beta_k x_k + \lambda A + \gamma I)}},$$

where $R = 1$ if the soldier reenlisted, and 0 if the soldier did not reenlist.

Table 6
Explanatory Variables to Predict Participation in ACES Program

Explanatory Variables	Survey Question in the 1999 SADP	Administrative Data Source
Academic Achievement/ ability at Accession		
• AFQT percentile	NA	PEF or Project First-Term
• Have GED	Q105	PEF or Project First-Term
• High school diploma	Q105	PEF or Project First-Term
• Some college	Q105	PEF or Project First-Term
Demographic Characteristics		
• Age at accession	NA	PEF or Project First-Term
• Sex	Q101	PEF or Project First-Term
• Marital Status	Q54	PEF or Project First-Term
• Military spouse	Q55	PEF or Project First-Term
• Race/ethnicity	Q103, Q104	PEF or Project First-Term
• Number of dependents	Q59	PEF or Project First-Term
Career		
• Occupation	NA	PEF or Project First-Term
• Time in service	Q110	PEF or Project First-Term
• Current contract obligation length	Q29, Q30, Q36	PEF or Project First-Term
• Career intentions when first enlisted	Q22	NA
• Education aspirations when first enlisted	Q23	NA
Satisfaction With Military Lifestyle		
• Measure of time spent on assignments away from home	Q14-Q17, Q21	NA
• Other measures of satisfaction	Q40-Q43, Q51	NA
• Intention to reenlist	Q32	NA
Enlistment Contract		
• Army College Fund (ACF) "kickers"	NA	Model eligibility criteria
• Montgomery G. I. Bill	Q23-Q25	DEERS
Access to ACES Programs		
• Assignment outside the Continental United States (OCONUS)	Q5	PEF or Project First-Term
• Installation has Education/Learning Center	NA	PEF or Project First-Term, combined with EDMIS
• Member works extra job during off-duty time	Q85-Q87	NA

- A fourth approach is to examine ACES program history to identify "natural experiments" caused by changes in program eligibility requirements. Program effects would be measured based not necessarily on actual participation, but on the opportunity to participate. The measured impact would be the impact of the program on the soldiers who had access to the program compared to soldiers who did not, after controlling for other differences between the two groups that might potentially affect outcomes. Because the individual's actual choice to participate or not is not used as the treatment indicator, potential self-selection bias is reduced.

The problem with self-selection is that, because it is an unobservable variable, one is never certain of the extent to which the control variables have successfully captured the influence of the unobservables on the estimated relationship between ACES participation and the dependent variable.

Censored data. This evaluation will analyze data on soldier participation in ACES and various soldier outcomes that occurred during a specified period of time (e.g., between 1999 and 2001). Because the observation period does not cover the full military career of some soldiers, the researcher does not have knowledge of events that occurred prior to 1999 (i.e., "left" censoring) or after 2001 (i.e., "right" censoring). Sample attrition might cause additional right censoring. For example, in an analysis of promotions, some soldiers might separate from the Army during the observation period (e.g., for medical reasons). Thus, the researcher does not observe a promotion that might have occurred had the soldier remained in the Army. There are two distinct censoring issues relevant to this evaluation—censoring of ACES participation, and censoring of the soldier outcomes of interest.

As discussed previously, electronic data on ACES participation prior to 1999 are not available for some soldiers. That is, ACES participation data are left censored for some soldiers. Censoring is likely to be a greater problem for soldiers who have more time in service or were assigned overseas prior to 1999. Time in service and overseas assignment both might be correlated with soldier reenlistment behavior and job performance. Consequently, even though one can identify soldiers for whom there might be incomplete ACES participation data, simply omitting these soldiers from the analysis could introduce bias in the findings.

Censoring means that ACES participation data will be measured with some degree of inaccuracy depending on how participation is measured. Measures of recent participation will not be censored, while measures of "ever" participated will be censored for some soldiers. The likely result is that the estimated relationship between the censored variable "ever participated" in ACES and the outcome of interest will be biased towards zero (that is, no effect). The cohorts discussed previously were chosen to minimize the problem with censoring. For Cohort 1, accessions in FY 1999, there should be very little censoring.[29] For cohorts 2 through 4, however, only data on ACES participation during the most current three years (i.e., 1999 through 2001) will be available producing left censoring for these cohorts.

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[29] EDMIS participation data will be missing before January 1999 for a small number of sites that would represent very unlikely assignments for soldiers in their first three months of service. Furthermore, these soldiers are in training, and not likely to participate in ACES programs.

Censoring is also a problem with some of the soldier outcomes of interest—especially when the outcome is related to the timing of an event (e.g., timing of promotions or timing of separations). For example, as noted above, in a study of whether ACES participation affects the timing of promotions, some soldiers will separate from the Army and thus not realize a promotion that would have occurred had the soldier remained. Survival analysis allows one to control for censoring of the dependent variable.

Missing data. Data on the analysis cohort might be missing for several reasons. First, a particular measure of a soldier characteristic might not be collected or might be unobservable to the researcher. Second, poor record collection or management could result in missing values for selected variables. Third, data in administrative files might be purged or overwritten because of storage limitations.

The first reason can complicate the analysis in two ways. As discussed previously, unobserved characteristics that are correlated with both the outcomes of interest and ACES participation (or other explanatory variables in the model) could bias the findings (i.e., omitted variable bias). In an analysis of attrition, if the missing characteristic is correlated with timing of attrition but not correlated with the explanatory variables in the model then the baseline hazard rates might be biased (i.e., unobserved heterogeneity bias). Unobserved heterogeneity is discussed later.

Poor data collection or management could result in incomplete data on soldiers. Although EDMIS has helped to standardize the ACES data collection process, there still might be variation across installations in the completeness and accuracy of soldier records on participation in various ACES programs.[30] The information we have obtained from PERSCOM indicates that there is variation across installations in the accuracy of recording some EDMIS variables. The extent of the problem will not become apparent until the data collection process.

The extent of the missing data problems will not be apparent until the data have been collected and preliminary analyses performed. If there does appear to be a problem with missing data, then appropriate statistical techniques to minimize the problem can be identified and applied.

Measurement error. Measurement error occurs when precise measures of a particular variable of interest are not available. The biases introduced by measurement error can be severe. For this analysis, measurement error is a potential problem for two key variables—ACES program participation and soldier job performance.

- Alternative measures of ACES participation differ in their ability to capture the degree to which soldiers use ACES services. For example, participation in the tuition assistance program could be measured using (a) a dichotomous measure of ever having participated in the program, (b) number of credit hours taken, (c) number of courses taken, and (d) type

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[30] A previous study of ACES (Brink et al., 1981) found missing ACES participation data to be a common phenomenon. This study, though, predates EDMIS and collected information on ACES participation by extracting the data from soldier personnel files.

of courses taken. Furthermore, some courses might be directly relevant to the soldiers' current job, while other courses might have little relevance to the soldiers' current job.

- Little information on job performance is systematically collected in the Army and stored in soldiers' personnel records. Measures that are collected typically are not comprehensive, but deal with specific requirements (such as marksmanship and level of physical fitness) or pertain to specific military occupational specialties (such as scores on proficiency tests). For this reason, researchers often use promotions (and demotions) as an indicator of superior (inferior) performance. Both the occurrence of promotions and how quickly they occur are indicators of performance. Promotions, though, are imprecise measures of job performance, and factors other than performance that affect promotions (e.g., time requirements) decrease the precision of promotions and timing of promotions as indicators of job performance.

Unobserved heterogeneity versus state dependence. Unobserved heterogeneity is the name given in the economics literature to the unobserved, individual-specific factors affecting behavior. The issue of self-selection in ACES participation discussed above is an unobserved heterogeneity issue. A different, but related, issue that is especially relevant to the study of attrition is the effect of unobserved heterogeneity on when members separate from the Army. If unobserved differences across members affect whether they separate prior to contract completion and the timing of separations, it might be difficult to discern whether attrition rates change over time due to tenure, or whether members with higher probabilities of attrition are systematically selected out of the Army.[31]

Consider the following example. Soldiers with less taste for military life are more likely to separate by choice early during their enlistment so that over time the remaining sample is increasingly made of up of soldiers with a higher taste for military life. Thus, initially the estimated hazard rate reflects the average of the hazard rates for all soldiers, but over time the hazard rate becomes more like that of the soldiers with higher taste for military life.[32]

Likewise, the hazard rate is a function of the state of events that take place during the enlistment period. The state of events differs during basic training, advanced individual training, and the post-training environment. Military life is, arguably, the most restrictive during basic training, followed by advanced training, followed by the post-training environment. Consequently, soldiers are more likely to separate by choice during basic training, followed by advanced training, followed by the post-training environment. Thus, it might be difficult to determine if declining attrition hazard rates in the sample are due to unobserved heterogeneity, or due to the nature of the enlistment lifecycle itself and, in particular, the increasing attractiveness

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[31] Another variant of unobserved heterogeneity and state dependence is the ability to distinguish between cohort and time effects. The only source of variation in some explanatory variables (e.g., economic conditions) is over time. Trends in economic conditions might correspond with the natural decline in the attrition rate over the course of the first-term enlistment, thus masking the true relationship between attrition and its explanatory variables.

[32] The hazard rate is the likelihood of separation between time period t and t+1, given that separation has not occurred prior to t (see footnote #25).

of Army life as soldiers move through and complete the training process. This is a concern because soldiers are more likely to participate in various ACES programs at different stages of their career. During the first part of the enlistment when attrition is relatively high, soldiers typically do not participate in ACES. During the later part of the enlistment when attrition is lower, soldiers will have had greater opportunity to participate in ACES. Consequently, without controlling for unobserved heterogeneity one might overestimate any effect that ACES has on reducing attrition.

The Retention Analysis

Why do soldiers stay in the Army or leave? Knowing what factors increase reenlistment rates and decrease attrition is of vital importance to the Army because of the high cost of turnover in terms of workforce planning and the high costs to recruit and train replacements for soldiers who leave. Numerous studies in the military and civilian literature have analyzed the issue of turnover to identify those factors that an organization can change to improve retention. Griffeth and Hom (1995), in their review of the civilian literature on employee turnover, wrote that:

> *Prescriptions for reducing employee turnover abound...However popular, such advice often rests on dubious or nonexistent empirical underpinnings. All too often, practical remedies are derived from case studies or anecdotal evidence. Rigorous research on practical interventions—especially those using quasi-experimental or experimental designs—is remarkably scarce (p. 193).*

The purpose of this evaluation plan is to help ensure a rigorous evaluation. The proposed methods and model specification build on the most rigorous studies in the civilian and military literature. A conceptual model is first described that summarizes the hypothesized effect that ACES program participation and other factors have on soldier retention. Separate conceptual models are presented to describe the reenlistment decision and attrition.[33] Testable hypotheses are derived from the conceptual models that help to answer the questions posed in the Introduction to this plan. Finally, an appropriate functional form, statistical techniques, and data are identified to perform the analyses of reenlistments and attrition.

In addition to estimating multivariate regression models to control for selection bias, the evaluation should provide tabulations depicting the number of soldiers who participate in various ACES programs and compare retention rates for soldiers who do and do not participate in the various programs. Also, the analysis should provide separate analyses for subgroups of soldiers—e.g., by rank, sex, race/ethnicity, occupation, and, where possible, Army career intentions.

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[33] Some studies in the military literature on retention model reenlistments and attrition together. The impact of ACES on retention, however, will likely differ in its impact on reenlistments and its impact on attrition. Consequently, conducting separate analyses of reenlistments and attrition is more appropriate than a combined analysis.

Reenlistment

The conceptual model. The military and civilian literature on employee retention identifies many factors that have been shown, or are hypothesized, to influence turnover behavior. To isolate the effect of ACES program participation on reenlistments, it is important to identify and control for factors that potentially affect soldiers' reenlistment behavior.

One category of factors is compensation and benefits. If soldiers perceive that their expected earnings (e.g., basic pay, special pays and allowances, and retirement pay) and benefits (e.g., healthcare coverage) from remaining in the military are lower than can be received in the civilian sector, then soldiers are more likely to leave the Services.[34] A second category of factors is quality-of-life issues. This includes factors such as the hardship associated with frequent or lengthy deployments, the characteristics of one's job, and satisfaction with the Army lifestyle. In general, the more that the quality-of-life factor adds to the soldiers' level of satisfaction (or "utility") the greater the retention effect of that factor. A third category is soldier demographic characteristics. Often, these factors are included in empirical analyses without thought for why these factors are expected to affect the outcome of interest. Factors such as race, sex, and level of education might be indicators of potential job opportunities and earnings in the civilian sector. Factors such as marital status and number of dependents might reflect the costs of military hardship on the family (and thus interact with quality-of-military-life-issues), or these factors might be proxies for the services the military provides to families.

Generally, no single factor is decisive in causing employees to separate or reenlist, and isolating the effect of ACES on the reenlistment decision requires the use of fairly complex analytical techniques. Consider the following simplified model of how ACES program participation might affect a soldier's decision to reenlist. Let Y_{it} represent the reenlistment outcome of individual i at time period t. Furthermore, let A_i be an indicator of the "treatment"— i.e., that the individual soldier has participated in a particular ACES program. Then, the equation $Y_{it}=f(X_{it}, A_i)$ describes the effect that ACES participation has on the soldiers' outcome, where X is a vector of other variables potentially affecting the outcome, and $f(...)$ is the functional form of the estimation equation.

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[34] Studies of military retention often estimate an Annualized Cost of Leaving (ACOL) Model in which the ACOL value is equal to the annualized difference between military and civilian pay over an optimal time horizon or period of stay in the military. To calculate the ACOL variable, assume that an individual can stay in the military for a maximum of "n" more years, and will stay in the labor force "T" more years, regardless of when he or she leaves the military. The ACOL is calculated using the following equation:

$$ACOL_n = \sum_{k=1}^{n} d^k (M_k - W_{k0}) + \sum_{k=n+1}^{T} d^k (W_{kn} - W_{k0}),$$

where M_k is expected military pay in year k ($k = 1, 2,...,n$); W_{k0} is future potential civilian earnings from leaving immediately ($k = 1,2,...,T$); W_{kn} is future potential civilian earnings from staying n more years, where civilian wages are conditional on n years of military experience ($k = n+1, n+2,...,T$); d^k equals $\left(\frac{1}{1+r}\right)^k$; and r is the personal discount rate.

Retention is often modeled using a random utility model that highlights the roles of expected utility from remaining (U^R) in the military versus the expected utility from leaving (U^L).[35] One does not directly observe the expected utility of remaining in the Service. One does, however, observe when the expected utility of remaining is greater than that of leaving. Such a positive net utility for remaining would be indicated by the soldier's choice to remain.[36]

Hypotheses derived from the conceptual model. The conceptual model can be used to derive testable hypotheses describing the effects of ACES on reenlistment decisions. Although these expected effects are derived rationally from the model, they are often consistent with a large body of empirical research. As Table 7 illustrates, theory can provide some guidance on the likely direction of the relationship between the decision to reenlist and its determinants. However, the magnitude of the relationships must be determined empirically. To the extent that ACES services improve the soldiers' quality of life and increase promotion potential, participation in ACES programs would be predicted to improve retention. However, some ACES programs might have contradicting effects on retention. For example, taking college classes funded by TA can increase the likelihood of promotion within the Army, while it also increases the soldier's earnings potential outside the military. Thus, this program could have mixed effects on reenlistment rates. Programs that are operational in nature, such as MOS improvement courses, primarily affect the utility of staying in the Army.

The effect of ACES participation on retention will likely differ by ACES program. ACES programs that provide military-specific knowledge and skills (e.g., MOS Improvement Courses)

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[35] Mathematically, the random utility model is specified:

$$\left(U^R - U^L\right)_{it} = f(A_i, X_{it}).$$

The net utility of remaining at time t is given by:

$$(U^R - U^S)_t = \beta'X_t + \lambda A + \gamma I + \varepsilon_t,$$

where X is the matrix of explanatory variables; β is a vector of parameters that describe the relationship between the explanatory variables and the net utility of remaining; λ is a parameter that describes the relationship between ACES program participation and the net utility of remaining; I and γ are, respectively, the Inverse Mills Ratio to control for self-selection into ACES and the parameter for this variable; and ε is a random error term.

[36] Thus,

$$P_t = \text{Prob}(\text{Remaining}_t)$$

$$= \text{Prob}(\sum_{t=t'}^{T} (\beta'X_t + \lambda A + \gamma I + \varepsilon_t)/(1+j)^{t-t'} > 0 \,|\, X_t)$$

$$= \text{Prob}(\tilde{\alpha} + \tilde{\beta}'X + \tilde{\lambda}A + \tilde{\gamma}I + \tilde{\varepsilon} > 0 | X_t).$$

That is, the probability of remaining at time t is a function of the net utility of remaining at time t, which is a function of the net utility of remaining during each period after t (i.e., at time $t+1$, $t+2$, ...T) discounted to the present time. This model can be estimated using either logistic regression or a probit analysis.

might have a substantially different effect on retention than programs that provide knowledge and skills that are transferable to the private sector (e.g., Tuition Assistance).

The following are examples of testable hypotheses that can be derived from the conceptual model. These examples apply to the tuition assistance program, but similar hypotheses can be developed for each ACES program

- *Participation in the tuition assistance program increases the propensity of soldiers to reenlist.* This hypothesis can be tested using an indicator of TA participation.

Table 7
Likely Effects of Education Program Participation on Reenlistment

Consequence of ACES Participation	Expected Effect on Reenlistment Based on Theory
The Army Tuition Assistance Program	(?)
• Increase earnings potential in the private sector	-
• Increase promotion potential	+
• Benefit might raise soldier's commitment to the Army	+
The SOCAD Program	(?)
• Increase earnings potential in the private sector	-
• Increase promotion potential	+
The FAST Program	(+)
• Make soldier eligible for reenlistment	+
• Increase promotion potential	+
MOS Improvement Courses	(+)
• Improve work satisfaction	+
• Increase promotion potential	+
NCO Leader Development Courses	(+)
• Improve work satisfaction	+
• Increase promotion potential	+

- *The degree of participation in the tuition assistance program affects the propensity of soldiers to reenlist.* This hypothesis can be tested using measures of TA participation such as total tuition assistance received by soldiers and total credit hours earned.

- *Tuition assistance has a greater effect on retention than other ACES programs.* Determining whether the total effect of TA participation on the propensity to reenlist is statistically greater than the effect of other ACES programs can test this hypothesis.

Model specification and estimation. Conventional probability modeling techniques, such as estimating a logit model, can be used to estimate the conceptual model described above. Separate models should be estimated for cohorts 2a, 2b, and 5. In addition, separate models should be estimated to analyze the first year, second year, and other year reenlistment decisions.

The dependent variable for this analysis is whether the soldier reenlists (for cohorts 2a, and 2b), or whether the soldier intends to reenlist (cohort 5). The dependent variable based on

administrative data is dichotomous and takes on the value of 1 if the soldier reenlists, and 0 if the soldier separates.[37] The 1999 SADP asks soldiers their intention to reenlist, and soldiers are asked to respond on a five-point scale: very likely, likely, neither likely nor unlikely, unlikely, or very unlikely. The survey responses to this questions could be coded as a dichotomous variable (e.g., 1=very likely or likely to reenlist, and 0=all other responses) and estimated using logistic regression. Alternatively, an ordered probit model could be estimated that predicts soldiers' responses to the five-point scale.

Appropriate explanatory variables to include in the regression analysis are listed in Table 8. These variables come primarily from the earlier research studies that were described in our literature review (see Table 3). The measures of ACES program participation can be modeled as indicator or "dummy" variables that take on the value of 1 if the soldier participated in the program, and 0 otherwise. Alternatively, the level of participation can be modeled for some programs (e.g., number of credits taken through the tuition assistance program). Not all the ACES participation variables will apply to each cohort analysis. For example, participation in NCO leadership courses might not be relevant for studying the first-term reenlistment decision.

After estimating the logistic regression model(s), several steps should be taken to validate the findings. The first is to have area experts review the findings to judge whether they are plausible. The second and related step is to compare the findings to estimates from related studies. For example, the estimated effect of ACES participation on soldier retention should be compared to the estimated effects of other factors (e.g., retention bonuses) on retention to determine if the estimates appear plausible. Finally, by estimating separate models with the 1999 SADP data and the administrative data, one can compare the two models to determine if the findings are consistent.

Attrition

The conceptual model. Most attrition occurs in the early stages of the first enlistment before the soldier has the opportunity to participate in most ACES programs. Consequently, the analysis of attrition focuses on the FAST program and MOS Improvement Courses, which are used by soldiers earlier in their military career. Both of these educational opportunities can improve soldier skills that are required for effective performance of their job. This improvement might increase the soldier job satisfaction, and consequently reduce the propensity of a soldier to separate prior to contract completion.

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[37] An alternative specification is to distinguish between "good" and "bad" turnover. Under this specification, the variable would take on the value of 1 if a soldier reenlists or if the soldier leaves because he or she is not eligible for reenlistment, and 0 if a soldier who is eligible for reenlistment leaves. Alternatively, the analysis could be restricted to those who are eligible for reenlistment.

Table 8
Potential Explanatory Variables for the Reenlistment Analysis

Explanatory Variables	Administrative Data Source
Academic Achievement/Ability	
• AFQT percentile	PEF
• Have GED	PEF
• High school diploma	PEF
• Some college	PEF
• Changes in educational level since accession	PEF
Demographic Characteristics	
• Age at accession	PEF
• Sex	PEF
• Marital status at accession	PEF
• Changes in marital status since accession	PEF
• Race/ethnicity	PEF
Career	
• Occupation at accession	PEF
• Change in primary MOS since accession	PEF
Bonuses/Pay	
• Military pay and benefits compared to expected civilian pay and benefits	ACOL Calculation
Enlistment Contract	
• ACF "kickers"	Probability estimate based on accession year, MOS, and AFQT score
• Montgomery G. I. Bill eligibility	Probability estimate based on AFQT score
• Length of current enlistment obligation	PEF
Economics Factors	
• Unemployment rate at ETS date in state where soldier is legal resident	PEF & Department of Labor
Training Phases Completed	
• Basic training	PEF
• Advanced Individual Training	PEF
Education Program Participation While On Active Duty	
• Tuition Assistance	EDMIS
• SOCAD	SOCAD Agreement Databases
• FAST	EDMIS
• MOS Improvement Courses	EDMIS
• NCO Leader Development Courses	EDMIS

One can model voluntary attrition using a random utility model similar to that formulated by Hogan (1979) and Hogan, Smith and Sylwester (1991).[38] This model highlights the roles of expected utility from remaining in the military versus leaving, the enlistment contract length, and the "cost" of breaking the enlistment contract. If the net benefits of remaining in the military at time t exceed the costs of remaining in the military—including the opportunity cost of working in the civilian sector—then the member remains in the military.[39]

Neither the net utility of remaining in the service nor the cost to the soldier of separating are directly observed. One does observe, however, by soldiers' choice to remain or leave, whether the cost of remaining outweighs the cost of leaving.[40] Policies that raise the cost to the soldier of separating, (i.e., that increase C_t) will reduce attrition.

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[38] Hogan, Smith and Sylwester (1991) model the effect of the Army College Fund on attrition and reenlistment. They find that supplemental education benefits have only a small effect on contract completion.

[39] Consider the random utility model where U_t^R denotes a soldier's dollar value of utility of remaining in the military at time t, and U_t^L denotes the dollar-equivalent utility in period t from leaving. Thus, the net utility of remaining at time t is given by:

$$(U^R - U^L)_t = \beta'X_t + \lambda A + \gamma I + \varepsilon_t,$$

where X is a matrix of explanatory variables; A is a measure of ACES participation; I is the Inverse Mills Ratio; β, λ, and γ are parameters that describe the relationship between the explanatory variables and the net utility of remaining; and ε is a random error term.

Let C_t be the cost at time t of breaking the enlistment contract. The cost of breaking the enlistment contract could include the negative utility associated with a bad discharge, or the difficulties of securing an early separation. Then, at time t', an individual will break the enlistment contract if:

$$\sum_{t=t'}^{T}(\beta'X_t + \lambda A + \gamma I + \varepsilon_t)/(1+j)^{t-t'} < C_t,$$

where T is the expiration of the contract.

Note the implications of the model. The soldier has an incentive to break the contract if the utility of remaining is lower then the utility of separating. To the extent that the ACES program can improve the utility of staying, it can reduce attrition. Also, the longer the soldier must endure a negative $\beta'X$—i.e., the greater the remaining term of service—the more likely that soldier is to separate.

[40] Thus,

$$P_t = \text{Prob}(\text{Separating}_t)$$

$$= \text{Prob}(\sum_{t=t'}^{T}(\beta'X_t + \lambda A + \gamma I + \varepsilon_t)/(1+j)^{t-t'} < C \mid X_t)$$

$$= \text{Prob}(\sum_{t=t'}^{T}(\beta'X_t + A + \gamma I + \varepsilon_t)/(1+j)^{t-t'} - C < 0 \mid X_t)$$

$$= \text{Prob}(\tilde{\alpha} + \tilde{\beta}'X + A + \gamma I + \tilde{\varepsilon} - C < 0 \mid X_t).$$

Hypotheses derived from the conceptual model. Testable hypotheses, derived from the causal model described above, provide insight as to the likely effects of ACES participation on attrition. Factors that increase the utility of remaining in the military might decrease the likelihood of attrition. Likewise, factors that increase the utility of "civilian" life might increase the likelihood of attrition.

This study would have the ability to empirically test several hypotheses regarding the relationship between ACES participation and attrition. The following are examples of hypotheses that can be tested.

- Participation in the FAST program reduces attrition for eligible soldiers

- Participation in MOS Improvement Courses reduces attrition.

- The impact of ACES on attrition differs by soldier characteristics (e.g., Army career intentions, or whether possessed a high school degree at the time of accession).

Additional, compounding factors that affect the decision to separate might make it difficult to isolate the effect that ACES has on attrition. Klein, Dawson and Martin (1991) found that most recruits who leave prior to completing the first 35 months of their enlistment do so for a combination of two or more reasons. The most common reasons for early separation are work or duty problems, training problems, minor offenses, and mental and health problems. Often these problems are interrelated and confounded by problems with drug and alcohol abuse or a negative attitude. While it seems reasonable to hypothesize that work and training problems can be ameliorated by participation in ACES programs, such as FAST and MOS Improvement Courses, other reasons for attrition will be relatively unaffected by ACES participation.

Model specification and estimation. The conceptual model can be estimated using conventional probability modeling techniques such as logistic regression (to model whether a soldier separates prior to contract completion) and survival analysis (to model both the occurrence and timing of events). Possible explanatory variables to include in the attrition analysis are listed in Table 9. Our review of the research literature addressing attrition, presented in the previous section, lists some of the studies in which the effects of these variables on attrition were established (see p. 22). These variables are also similar to (or variations of) explanatory variables used in other attrition studies (e.g., Hogan, Smith and Sylwester, 1991; Klein and Martin, 1991) or in the empirical literature on retention (see Table 3).

Some of these explanatory variables could be modeled as interaction terms. For example, Klein and Martin (1991) modeled the interaction of race/ethnicity with AFQT score, and with age in their study of first-term attrition.

Table 9
Potential Explanatory Variables for the Attrition Analysis

Explanatory Variables	Administrative Data Source
Academic Achievement/Ability	
• AFQT percentile	Project First-Term Database
• Have GED	Project First-Term Database
• High school diploma	Project First-Term Database
• Some college	Project First-Term Database
• Changes in education level	Project First-Term Database
Demographic Characteristics	
• Age at accession	Project First-Term Database
• Sex	Project First-Term Database
• Marital status at accession	Project First-Term Database
• Changes in marital status since accession	Project First-Term Database
• Race/ethnicity	Project First-Term Database
Career	
• Occupation at accession	Project First-Term Database
• Change in primary MOS since accession	Project First-Term Database
Bonuses/Pay	
• Military pay and benefits compared to expected civilian pay and benefits	ACOL Calculation
Enlistment Contract	
• ACF "kickers"	Probability estimate based on accession year, MOS, and AFQT score
• Montgomery G. I. Bill eligibility	Probability estimate based on AFQT score
• Length of current enlistment obligation	Project First-Term Database
Economics Factors	
• Unemployment rate at accession date in state where soldier is legal resident	Project First-Term Database & Department of Labor
Training Phases Completed	
• BASIC training	Project First-Term Database
• Advanced Individual Training	Project First-Term Database
Education Program Participation While On Active Duty	
• The FAST Program	EDMIS
• MOS Improvement Courses	EDMIS

The Performance Analysis

Numerous studies in the civilian literature have shown that additional academic training improves job performance. Two challenging issues for this evaluation are (a) how to measure job performance, and (b) how to isolate the impact of ACES program participation on job performance. Because general job performance measures are not collected systematically by the Army to be included in administrative records, the evaluation study must use surrogate measures, such as MOS reclassification and the occurrence and timing of promotions.[41]

As discussed previously, promotions are an imprecise measure of job performance because additional factors are considered in the promotion process (e.g., time requirements and availability of promotion slots). In addition, promotions at higher ranks might be thought of as a "tournament" in which all the candidates are highly qualified. Consequently, there might be little variation among candidates for promotion in terms of their job performance. For example, all the candidates might have participated in a continuing education program. Consequently, gross measures of participation may not show an effect on promotions. However, more refined measures, such as the number of courses or semester hours taken, may distinguish among candidates, even when all of them have participated to some extent. In addition, measures that indicate a long-term commitment to CE, such as completion of the requirements for a degree,[42] may also distinguish among candidates for promotion at higher levels.

Using promotions to measure job performance introduces a second conceptual problem for this part of the evaluation – namely, that promotion points are given for the successful completion of specific ACES programs.[43] Thus, ACES program participation has a direct effect on promotions regardless of the effect of program participation on actual job performance. Use of a more refined measure of participation, such as semester hours taken, and consideration of degrees attained should make it possible to identify effects of ACES participation in addition to those caused directly by the promotion points that are earned from the participation.

One possible approach to determine the effect of ACES participation above and beyond the promotion points is includes the following steps. First, determine the expected number of

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[41] Garcia et al. (1998) analyzed demotions as an indicator poor job performance. Demotions, however, often occur for disciplinary reasons that are not directly related to a soldier's ability to perform his or her job.

[42] Degree attainment is not recorded directly, either in EDMIS or through SOCAD. It can be inferred from a change in the educational credentials recorded in administrative records.

[43] Formal education is an important component of a soldier's professional development. The Army recognizes a soldier's educational attainment by awarding promotion points, for some ranks, when the soldier achieves certain scholastic milestones such as completing courses or completing an academic degree. For example, for some ranks, promotion points are awarded for obtaining a high school diploma or general education development (GED) equivalent, for completing any accredited post-secondary test while on active duty, and for each semester hour earned at an accredited trade school, college, or university. Furthermore, enlisted soldiers cannot be promoted to the rank of Sergeant or higher without a high school diploma or GED. Data on participation in the TA program are available in the EDMIS. Promotion points are awarded for satisfactory completion of the DANTES sponsored examination program, the CLEP general and subject examinations, and the ACT proficiency exams. Also, see footnote #20.

promotion points the soldier would receive based on the number of college credit hours taken or degrees attained. Second, using data on ACES participants, estimate a logistic regression model of the probability of promotion. The explanatory variables in that regression would include the estimated number of promotion points given for ACES participation, measures of ACES participation that do not result in promotion points (e.g., college credit hours above the maximum used to award promotion points), and other variables that are expected to affect the probability of promotions (e.g., MOS and time in grade). A significant effect of ACES participation variables in this model would indicate that participation in ACES has a direct effect on promotion in addition to the effect that it has on promotion points.

In addition, the evaluation can look at job reclassification as a measure of how ACES affects job performance in the military. Although job reclassification is not a direct measure of soldier performance, if a soldier is reclassified to an MOS that better matches his or her abilities or his or her career goals then a reclassification can affect military readiness via its indirect effects on job performance and career satisfaction. Not all changes in MOS will be counted as a reclassification for purposes of this analysis. For example, changes in MOS that occur because an MOS is discontinued or renamed will not be counted as a reclassification in this analysis. Likewise, MOS changes that occur automatically as the result of a promotion (or a demotion) will not be counted as reclassification in this analysis.

The Conceptual Model

Many factors, including the academic training and leadership courses available through ACES, determine how well a soldier performs his or her job. Conceptually, one can think of the relationship between soldier performance and the determinants of performance as a production function:

$$performance = f(E, T, X),$$

where performance is determined in part by a soldier's education (E), training and experience (T), and other factors (X) such as personal characteristics (e.g., aptitude and motivation) and job characteristics (e.g., MOS).

Performance, in this conceptual model, is considered the output while education, training and experience, and selected soldier characteristics are considered inputs. An increase in one input into the production function is presumed to increase the output (i.e., performance), although the marginal increase in performance from a unit increase in the input might not be constant. For example, the relationship might be one of diminishing returns where the first unit of the input (e.g., one year of college) has a larger effect on performance than the second unit of the input (e.g., the second year of college), and so on.

In some cases the inputs might be substitutes and thus interchangeable. In other cases the inputs might be complements in which performance does not increase unless more than one of the inputs is increased. In some cases the inputs might interact so that increasing, say, education might affect the relationship between training and performance. To illustrate these points, consider the following examples. Education and soldier motivation are, to some degree, substitutes. A highly motivated but less educated soldier might perform at the same level as a

less motivated but more highly educated soldier. In addition, these two inputs likely interact in the production function. That is, the increase in performance for a highly motivated soldier who participates in an educational program might be different, and presumably higher, than the increase in performance for a less motivated soldier who participates in the same educational program.

Similarly, in many cases education and training might be considered substitutes. Likewise, education and training could interact such that education enhances the effect of training on performance. The direct effect of education on job performance, and the indirect effect of education on performance via its effect on training are illustrated in Figure 2. These interaction effects are incorporated into the conceptual model by modifying the production function discussed above:

$$performance = f\{E(E,T,X), T(E,T,X), X\},$$

where $E(E, T, X)$ is the direct effect of education on job performance and is a function of the type and amount of education received, training received prior to participation in a continuing education program, and soldier attributes such as motivation and intelligence; and $T(E, T, X)$ is the indirect effect of education on job performance via its effect on trainability.[44]
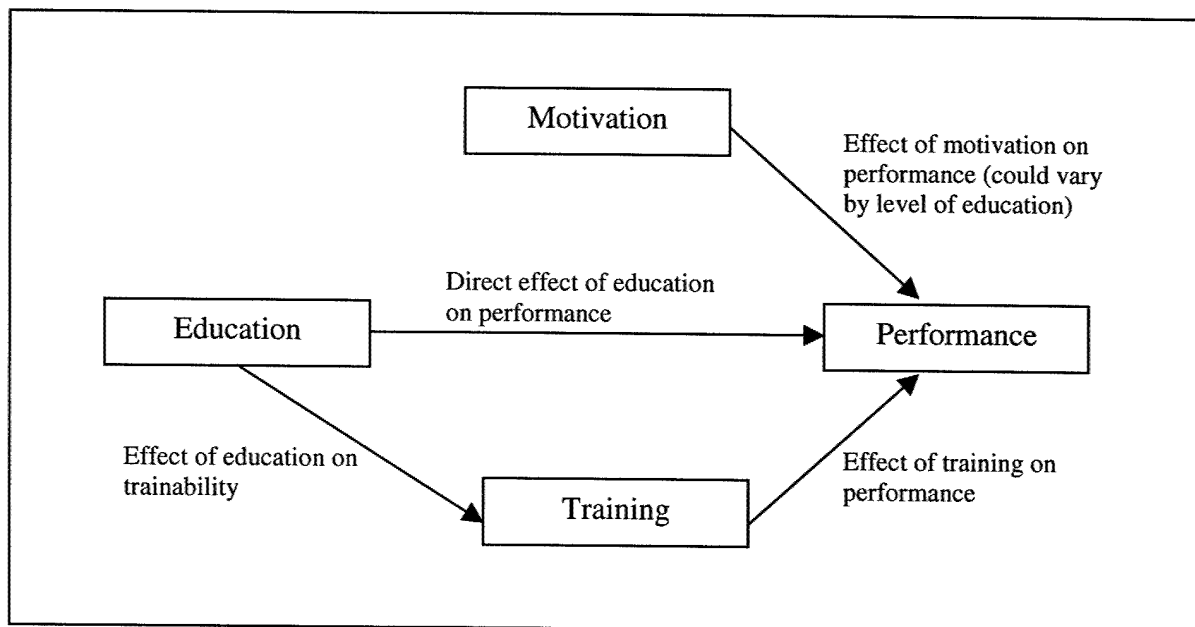

Figure 2. Relationship between education and performance.

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[44] One important question is whether educational attainment enhances trainability, or whether educational attainment simply is an indicator of a person's trainability.

Hypotheses Derived from the Conceptual Model

From the conceptual model one can derive testable hypotheses regarding the effect of various ACES programs on soldier job performance as measured by promotions and timing of promotions. As discussed previously, Cohorts 3a and 3b are designed to estimate the impact of ACES participation on promotion to E5, and Cohorts 4a and 4b are designed to analyze promotions to E6. Examples of testable hypotheses to address the questions posed in the Introduction include the following.

- Participation in the Army's Tuition Assistance Program increases the likelihood of an early promotion to E5 and E6.

- Participation in NCO leadership development courses increases the likelihood of an early promotion.

- The impact of ACES participation on the likelihood and timing of promotions differs by type of soldier (e.g., high school graduates verses non-graduates), by military job characteristics (e.g., by MOS), and by the type of academic courses taken through the ACES program.

- Participation in ACES increases the likelihood of an MOS reclassification.

Model Specification and Estimation

Ideally, the impact of continuing education on job performance would be measured using a "fixed-effects" model where information on job performance was collected both prior to and after completing the educational course. Then, each soldier would be his or her own control group. Unfortunately, such an analysis is not possible given the lack of a job performance measure that could be assessed before and after participating in the education program.

Consequently, the conceptual model described above should be estimated using cross-sectional data with a control for self-selection into the ACES program. Logistic regression can be used to model the impact of ACES participation on whether a soldier is promoted or changes MOS during the period of observation. Two approaches could be used to determine whether ACES participation affects the timing of promotions. One approach is to estimate a survival model (similar to the approach used to model attrition). The second approach is to predict the time to promotion based on ACES participation using an ordinary least squares (OLS) model. Both approaches have similar data requirements, but survival analysis provides a better treatment of censored data. Consequently, it is the preferred method for estimating the effect of ACES participation on the timing of promotions. Table 10 and Table 11 provide a list of explanatory variables for the promotion and reclassification analyses, respectively. Explanatory variables for the promotion analysis were identified in the literature review as summarized in Table 2. We are not aware of any comparable research regarding reclassification, and so have proposed the same explanatory variables to be used for that analysis.

In addition to estimating logistic regression models to determine the impact of ACES participation on promotions and MOS reclassification, the analysis should provide tabulations

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depicting the number of soldiers who participate in various ACES programs and compare promotion and reclassifications rates for soldiers who do and do not participate in the various programs. Also, the analysis should provide separate analyses for subgroups of soldiers—e.g., by rank, sex, race/ethnicity, and occupation.

The Cost-Benefit Analysis

Information on the costs and benefits of the ACES program to the Army is vital to allow the Army to allocate resources to those activities that are most beneficial to the service and its members. The preceding sections describe the process for calculating the benefits of ACES in terms of increased soldier retention and productivity. This section describes the process for quantifying the costs and benefits of ACES in dollars. Additional costs and benefits that cannot be quantified in dollars are identified.

Table 10
Potential Explanatory Variables for the Promotion Analysis

Explanatory Variables	Data Source
Academic Achievement/Ability at Accession	
• AFQT percentile	PEF
• Have GED	PEF
• High school diploma	PEF
• Some college	PEF
• Changes in education level since accession	PEF
Demographic Characteristics	
• Age[45]	PEF
• Sex	PEF
• Marital status	PEF
• Changes in marital status	PEF
• Race/ethnicity	PEF
Career	
• Occupation	PEF
• Changes in occupation since accession	PEF
Education Program Participation Since Last Promotion	
• The Army Tuition Assistance Program	EDMIS
• The SOCAD Program	SOCAD Agreement Database
• MOS Improvement Courses	EDMIS
• NCO Leader Development Courses	EDMIS

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[45] Age at time of promotion to E-4 (to analyze E-5 promotions) and age at time of promotion to E-5 (to analyze E-6 promotions).

Table 11
Potential Explanatory Variables for the MOS Reclassification Analysis

Explanatory Variables	Data Source
Academic Achievement/ ability at Accession	
• AFQT percentile	PEF
• Have GED	PEF
• High school diploma	PEF
• Some college	PEF
• Changes in education level since accession	PEF
Demographic Characteristics	
• Age	PEF
• Sex	PEF
• Marital status	PEF
• Changes in marital status	PEF
• Race/ethnicity	PEF
Career	
• Occupation	PEF
Education Program Participation Since Last Change in MOS	
• The Army Tuition Assistance Program	EDMIS
• The SOCAD Program	SOCAD Agreement Database
• MOS Improvement Courses	EDMIS
• NCO Leader Development Courses	EDMIS

Measures of Cost Effectiveness

Soldiers are considered a human capital asset. The military incurs costs to increase this asset, but also derives benefits in the form of higher levels of readiness. Like all assets, various measures exist that allow the Army to quantify its return on investment in human capital. The most appropriate measure for this analysis is the Net Present Value (NPV).

The NPV is the discounted future benefits minus discounted costs and is calculated:

$$NPV = \sum_{t=0}^{T} \frac{B_t}{(1+i)^t} - \sum_{t=0}^{T} \frac{C_t}{(1+i)^t},$$

where B_t and C_t are, respectively, the benefits and costs to the Army of ACES participation at time "t", and "T" is the expected date of separation from the Army. If the NPV is greater than zero, then program costs are more than offset by program benefits.

Discounting is important for this evaluation because the cost of ACES participation and the benefits derived might occur in different time periods. For example, soldier participation in

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continuing education might reap immediate returns in terms of increased soldier productivity, but the returns in terms of improved retention might not be realized until several years in the future. Most costs to the Army when a soldier participates in an ACES program are incurred up front. The timing of costs and benefits is of interest to the Army to ensure the Army receives a return on its investment. If completion of the academic training occurs early in the soldier's military career, then the military has time to recoup the investment. If, on the other hand, the training occurs immediately prior to separation from the military, then the military has little time to recoup the training costs.

Estimating Costs

Budget costs for many of the ACES programs and services are readily available. The cost estimates used in this evaluation, however, should include hidden program costs that might not be included in the ACES program budget—such as the cost of health benefits, retirement, and leave for program personnel, and other overhead costs.

Although most ACES programs provide soldiers with the opportunity to receive continuing education during off-duty hours, soldiers who participate in ACES might spend some on-duty time participating in an ACES program. For example, counseling services might be available only during working hours. The cost to the Army of soldier on-duty time spent participating in ACES should be included in the cost estimates.

Estimating Benefits

The expected major benefits of ACES participation are higher retention and improved job performance.

Reduced soldier separation and replacement costs. The value of a soldier to the Army is not easily quantifiable, but the separation and replacement costs resulting from attrition and decisions not to reenlist can be quantified. Separation costs include expenses incurred to process the departing soldier out of the Army, as well as pecuniary costs incurred by the Army for benefits promised to the soldier following separation. Replacement costs consist of recruiting and training expenses.

Table 12 identifies specific separation and replacement expenses incurred by the Army when soldiers separate. Separation and replacement costs will vary substantially by soldier depending on where soldiers are located, job type and years in the service.

The net cost to the Army of losing a soldier for failure to reenlist should include all the costs listed above minus costs the Army would have incurred if the soldier had re-enlisted—such as selective reenlistment bonuses.

Garcia et al. (1998) estimated the replacement cost to the Navy for each enlisted sailor who selects not to reenlist is approximately $24,301 in FY 98 dollars. This estimate, though, appears not to take into account attrition during various stages of the first enlistment. For example, if one third of accessions separate from the military prior to the end of the first enlistment, then the military must recruit approximately 150 persons to replace 100 persons who choose not to reenlist at the first enlistment decision. The military will incur recruiting costs and

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varying levels of training costs for all of these 150 accessions. Likewise, this estimate from Garcia et al. does not appear to include separation costs.

Table 12
Soldier Separation and Replacement Costs

Separation Costs
Outprocessing • Productivity loss when soldier is not functioning with unit • Administrative costs
Relocation • Soldier's household relocated • Administrative costs
Post-separation benefits • G.I. Bill
Recruiting Costs
Recruiting costs • Advertising • Recruiters • Testing (e.g., MET & MEPS centers) • Administrative costs
Training Costs
Training costs • BASIC • AIT • Training exercises • Other training programs

Some costs and benefits of separation are subtler and more difficult to measure. For example, some researchers have suggested that turnover has a demoralizing effect and thus breeds additional turnover. On the other hand, turnover might create promotion opportunities for those who remain, which has a positive effect on retention for those who remain. Also, a portion of soldiers who leave active duty will enter the Army Reserves or National Guard, which offsets part of the total loss to the Army when a soldier separates.

Griffeth and Hom (1995) suggest that exit costs might be overstated because they ignore the identity of employees who leave. For example, if poor-performing soldiers are more likely to leave than good performers then, on average, the replacement soldier will be of higher quality than the separating soldier. It might be in the best interest of the Army if low-quality soldiers leave after their first enlistment.[46]

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[46] Dalton, Todor, and Krackhardt (1982) introduced a taxonomy to classify turnover and identify turnover as "bad" if high performers leave or low performers stay, and "good" if high performers stay and low performers leave. This

Higher productivity. As described previously, the unavailability of precise measures of soldier productivity has led many researchers to use promotions as an indicator of improved soldier performance. In the civilian literature, however, many studies assume that an employee's wages equal his or her marginal productivity and thus use changes in wages as a proxy for changes in productivity.

In the military, this assumption that compensation equals marginal productivity is not valid. The Army invests significant resources to train soldiers. Increased training increases the value of soldiers to the Army with only a small and indirect effect on compensation. Thus, changes in pay likely would underestimate change in productivity. In terms of benefits to the Army, if changes in performance were perfectly offset by changes in compensation, then the net benefit in dollars of improved performance to the Army would be zero. In summary, if the evaluation finds that ACES participation increases promotions (or reduced the time to promotion), then the evaluation could consider using the increase in basic pay to quantify the value of increased performance. This measure has numerous limitations, though.

Summary

The purpose of this evaluation plan is to help ensure a thorough and rigorous evaluation of the impact of ACES on soldier retention and job performance. The plan first identifies questions that should be addressed in the evaluation and testable hypotheses to address these questions. Then, the plan identifies data sources and modeling techniques to test these hypotheses.

In addition, the evaluation plan identifies data and methodological issues that the evaluation must address to ensure accurate findings. The most serious issue is that soldiers select to participate in ACES. Many of the factors that are hypothesized to increase the propensity to participate in ACES are also hypothesized to affect soldier retention and job performance. Failure to control for selection bias will likely result in overestimation of the impact of ACES on Army readiness. Several approaches and statistical techniques are proposed to mitigate the adverse effects of selection bias on the program impact estimate.

Two types of data sources are discussed. The first is the 1999 Survey of Active Duty Personnel. This survey is a rich source of data for an analysis of reenlistment intentions and contains variables that indicate whether a soldier participated in certain ACES programs during the previous 12 months. The second source of data encompasses several administrative databases. Data on ACES participation from EDMIS and SOCAD databases can be merged with data on promotion and retention outcomes and soldier characteristics available in databases such as the PEF and Project First-Term Database. The administrative databases should provide more precise measures of ACES participation and soldier outcomes than will the SADP. The SADP, however, contains data on soldier intentions and satisfaction with various facets of the military that are not available in administrative databases. Furthermore, preparing an analysis database from SADP will require substantially fewer resources than preparing an analysis database from

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concept relies on the assumption that employers will replace employees who leave with employees of at least average performance. Consequently, low performers who leave are replaced with better performer, on average.

administrative files. In addition, the SADP can potentially be linked to the administrative data to provide an even richer database with which to analyze the impact of ACES on outcome measures and control for soldiers' satisfaction with various aspects of military life. For the reasons discussed above, both data sources are important to this evaluation. The merged SADP/administrative data file will be analyzed provided the sample size from the merged files is sufficient to conduct meaningful analyses.

Four analyses are proposed in the evaluation plan: (a) a reenlistment analysis, (b) an attrition analysis, (c) a reclassification analysis and (d) a promotion analysis. These analyses can be completed using conventional modeling techniques such as OLS regression, logistic regression, probit analysis, and survival analysis. Logistic regression and probit analysis can be used to model whether soldiers reenlist, and whether they complete their first enlistment. OLS regression can be used to predict the time to promotion. Survival analysis can be used to model the timing of both attrition and promotions. The retention analysis should focus on soldiers in their first and second enlistment, while the attrition study should focus on soldiers in their first enlistment. Because most attrition occurs early in the first enlistment before a soldier has the opportunity to participate in ACES (or even become aware of ACES), the impact of ACES on attrition, if any, is likely to be small. The promotion analysis should focus on promotions to E-5 and to E-6.

The evaluation plan discusses ways to quantify the costs and benefits of ACES using conventional cost-benefit measures. This information can be used to compare various ACES programs in terms of their value added to the Army, as well as how ACES programs compare to other Army programs in its contribution to Army readiness.

DATABASE DEVELOPMENT PLAN

Database Plan Objectives

The data requirements of an evaluation study can be complex, drawing from numerous and diverse data sources. This database development plan has a single objective: to ensure a sound and successful study by meeting all the data needs of the evaluation in the most efficient manner possible. This objective will be accomplished in three ways. First, the database plan will be based on a thorough assessment of the data requirements of the evaluation study. Therefore, the database plan will rely on the evaluation plan for such critical information as research design, statistical approach, identification of populations of interest, and data elements required. Both the evaluation and database plans draw heavily from one another. While it is clear that the database plan should be defined by the goals and requirements of the evaluation plan, it is also true that the latter cannot put forth reasonable guidelines without considering the limitations and availability of the former.

Second, this database development plan will review all relevant data sources, providing a discussion of the "goodness of fit" between the attributes of data from a number of sources and the requirements of the evaluation. The discussion will conclude with recommendations identifying those data sources that provide the richest, most efficient, and relevant data for use in the evaluation study. Third, the database plan will provide detailed guidelines for data procurement and the creation of an analytic database that will serve the complete data needs of the phase two ACES evaluation.

Evaluation Plan Data Requirements

Population Characteristics

Different ACES programs are designed to benefit soldiers at different points in their careers. For example, while participants in the FAST program tend to be newer accessions, NCO Leadership courses are designed solely for current or soon-to-be-NCOs. In addition to the fact that some ACES programs are relevant only at specific points in a soldier's career, evidence of the evaluation study's criterion measures is also often apparent only at particular points in time. For example, attrition is mostly a phenomenon of new accessions: nearly half of first-term attrition occurs within the first 12 months of service (Laurence, Naughton, & Harris, 1995). Obviously, the earliest evidence of reenlistment can occur only at or near the conclusion of the first term of service, and, thereafter, at the end of each subsequent term. Promotions from E-2 through E-4 are generally automatic, based on time-in-grade and, therefore, not of great analytic interest to the evaluation. Promotions to higher grades, however, which are typically based on performance and education, generally do not occur before completion of the first term of service.

In addition to these temporal constraints, there is the added limitation of the availability of ACES participation data. EDMIS is the Army's operational database containing information on ACES participation. As stated in the previous section, EDMIS was installed in a subset of CONUS installations as early as 1995, but nearly all Army bases, including OCONUS sites, had

EDMIS installed by January 1999.[47] The lack of complete EDMIS data prior to January 1999 is a serious data constraint that will be discussed in detail later.

Analysis Cohort Definitions

In defining its analytic cohorts, the evaluation plan takes into account a number of temporal issues, some of which have already been mentioned. First, as discussed above, evidence of the criterion measures and the relevance of various ACES programs for particular soldiers are both related to the specific stage in a soldier's career and substantially affect cohort definitions. Second, EDMIS data availability sharply limits the time period that education behavior in a cohort of soldiers can be observed. Lastly, the expected starting date of the evaluation study and, more importantly, its expected duration will influence cohort definitions. The evaluation plan assumes that the phase two evaluation study will commence in late FY 2001 and will be completed by the end of June 2003. While sufficient time must be allocated for database preparation and analysis, data must be collected at the latest possible date to allow for the inclusion of as much automated education participation data as possible in EDMIS. Assuming that three months is required to collect evaluation data and a little over a year to prepare the database, analyze the data, and write the evaluation report(s), then the project data will likely be collected starting in January 2002 to capture data through December 2001. Following this schedule, the evaluation study data will reflect, at best, three years of soldier education behavior (January 1999 through December 2001).[48]

The evaluation plan identifies five main Regular Army cohorts to be used in the evaluation. The first analysis cohort is defined as non-prior service FY 1999 enlisted accessions and will form the population used to analyze early attrition and reclassification.[49] Second, reenlistment analyses will be conducted on all enlisted soldiers with an ETS date in calendar year 2001.[50] Because this cohort includes soldiers in all enlistment terms terminating in 2001, the relationship between ACES participation and first and all subsequent reenlistments can be assessed from this cohort. Third, the relationship between ACES participation and promotion to

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[47] All but 8 facilities had EDMIS installed by December 1998. EDMIS was not installed in Europe, Japan, and Korea until September 1998, October 1998, and December 1998, respectively.

[48] It is important to note that facilities require time to learn the EDMIS system and set up the database correctly, although how much time is required is unclear. Therefore, while three years of complete EDMIS data will exist as of December 2001, some of these data may be unreliable, particularly in sites that began using EDMIS later in the EDMIS installation period of 1995-1998.

[49] For the 1999 cohort, soldier careers will be observed for a maximum period of 36 months and a minimum of 24 months, for January and December 1999 accessions, respectively. Except for two- and some three-year enlistments, the criteria are not "first-term" but rather "early" attrition and reclassification because the data do not allow the observation of soldier careers across the typical four-year term.

[50] Reenlistment can occur up to 8 months prior to the ETS date. Once reenlisted, a soldier's ETS date changes. Therefore, to identify only soldiers who had a 2001 ETS date in 2001 data would miss those soldiers who had a 2001 ETS, but reenlisted prior to 2001. To circumvent this problem, cohort members will be identified based on their ETS date 9 months prior to the beginning date of the period. In this case, cohort members would be identified from April 2000 data.

E-5 will be studied using the cohort of enlisted soldiers who were promoted to E-4 during calendar year 1998. Fourth, enlisted soldiers promoted to E-5 in calendar year 1998 will form the cohort used to analyze promotion to E-6. The cohorts used for both promotion analyses will consist of soldiers from different accession years and with varying number of enlistment terms. Fifth, the relationship between education participation and intention to reenlist will be analyzed on a cohort of survey respondents to items on attitudes on military life, including intention to reenlist and self-reported education participation.

Finally, the evaluation plan also suggests intersecting the survey cohort with the reenlistment and promotion cohorts[51] to produce additional cohorts of interest. The feasibility of this approach will depend in large part on the number of cases in the resultant cohorts. Table 13 presents a summary of these analysis cohorts, with an indication of criterion measures that they are designed to study.

Table 13
Summary of Cohorts by Criterion Measures

Cohort Definitions	Criterion Measure
Main Cohorts:	
FY 1999 enlisted accessions	Early attrition, early reclassification
Enlisted soldiers with ETS in calendar year 2001	Reenlistment (1st term and beyond)
Enlisted soldiers promoted to E-4 in calendar year 1998	Incidence and timing of promotion to E-5, reclassification
Enlisted soldiers promoted to E-5 in calendar year 1998	Incidence and timing of promotion to E-6, reclassification
Survey respondents	Intention to reenlist
Intersected Cohorts:	
Enlisted soldiers with a calendar year 2001 ETS date who are also survey respondents	Reenlistment (1st term and beyond)
Enlisted soldiers promoted to E-4 in calendar year 1998 who are also survey respondents	Incidence and timing of promotion to E-5, reclassification
Enlisted soldiers promoted to E-5 in calendar year 1998 who are also survey respondents	Incidence and timing of promotion to E-6, reclassification

Data Elements

The evaluation plan calls for a number of explanatory variables to be used in the attrition, reenlistment, reclassification, and promotion analyses. Individual soldier-level variables fall into two groups: (a) variables that describe the demographic and military job characteristics of a

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[51] The early attrition/reclassification cohort recommended for use later in this report is itself rich with attitudinal measures. Therefore, there would be minimal benefit in intersecting these cohorts.

soldier over a defined period of time, and (b) those that capture soldier attitudes, perceptions, and intentions at a single point in time. Explanatory variables that describe the demographic and military job characteristics of soldiers are either static or fluid in nature. Static variables, such as gender and race/ethnicity, are attributes that are not expected to change over the observation period of the study. Fluid attributes are those that can change over time. For example, MOS and CONUS/OCONUS assignments are fluid, time-varying attributes because they can (and often do) change over the evaluation study's observation period.

An observation period is the period of time during which the evaluation study examines data that describe a soldier's career and behavior. Observation periods differ by cohort. Table 14 presents the observation period beginning and ending points for the four main cohorts that utilize soldier-level demographic and military job/career data.

Table 14
Summary of Cohort Observation Periods

Cohort	Analysis	Observation Period	
		Begin	End
1999 Accessions	Attrition, Reclassification	Enlistment date in 1999	• Date of Separation • Date of Reenlistment • Data Cut-off Date
Soldiers with ETS in 2001	Reenlistment	Enlistment/Reenlistment Date	• Date of Separation • Date of Reenlistment • Data Cut-off Date
Soldiers promoted to E-4 in 1998	Promotion to E-5, Reclassification	Date in 1998 Promoted to E-4	• Date Promoted to E-5 • Separation • Data Cut-off Date
Soldiers promoted to E-5 in 1998	Promotion to E-6, Reclassification	Date in 1998 Promoted to E-5	• Date Promoted to E-6 • Separation • Data Cut-off Date

It is important to note that the end of the observation period is signaled by different events for different soldiers. For example, one of three events must occur to each soldier to punctuate the end of the 1999 accession cohort observation period: the servicemember (a) separates, (b) reenlists,[52] or (c) is still on active duty at the last point in time for which data are available.

Given that the goal of the evaluation is to assess the effect of education participation on performance and retention, it is clear that great care must be taken to measure explanatory variables at points in time prior to the occurrence of the criterion measure being analyzed. But at what point(s) in time should the evaluation capture time-varying variables? Unless variables change at predictable points during the observation period, choosing a particular point in time to capture a fluid variable can be likened to trying to hit a moving target: sometimes you can hit the

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[52] Reenlistments in the 1999 cohort can be observed for those with an initial 2-year enlistment term and for some servicemembers with an initial 3-year term.

target, but often you don't. For example, because soldiers can change MOS at any time, the timing of an MOS change cannot be predicted. If MOS is measured early in the promotion observation period, then subsequent changes to MOS – which may be highly related to promotion – will never be captured. Similarly, looking late in the observation period and measuring only the "changed" MOS can also lead to lost information – most notably, the effect of the original MOS on the criterion measure. To allow the most precision in building analytic models and to provide the evaluation analysts the most flexibility in building those models, data must be captured as often as possible during the observation period. In other words, longitudinal data must be collected to fully describe soldier demographic and military job characteristics.

Table 15 presents a list of the explanatory variables required by the evaluation plan for the attrition, reenlistment, reclassification, and promotion analyses. Time-varying soldier-level demographic and military variables are indicated on Table 3 with an asterisk. Although attitudinal and self-reported education can change over the life of a soldier, they can be captured at a single point in time and are therefore not considered time-varying variables in Table 15.

Summary of Data Requirements

The evaluation plan calls for three types of information on individual soldiers: (a) data on ACES participation; (b) administrative data, including personal demographics and military job characteristics; and (c) self-reported education participation and attitudinal (perceptions and intentions) measures. In addition, the evaluation plan uses external, economic measures (e.g., unemployment rates). Therefore, the most fundamental requirement of a data plan for this evaluation study is that it result in a database that contains the data elements listed in Table 15[53] on the cohorts specified by the evaluation plan for the relevant time periods.[54]

A further requirement is that the data source(s) selected must be the most cost- and labor-efficient of its genre, all other factors being equal. In addition, the evaluation plan requires complete ACES participation data, regardless of soldier location and the frequency of changes in soldier assignments. Complete data are important because the variation in education participation between soldiers should be attributable to soldier behavior rather than differences in electronic record keeping (or the lack of it) at various installations. It is for this reason that EDMIS data are deemed complete beginning in January 1999.

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[53] Additional variables to those listed in Table 15 will be requested for data exploration or for use in the construction of other variables.

[54] Temporal relevance dictates that the criterion measures post-date education participation and other explanatory measures.

Table 15

List of Explanatory Variables for the Attrition, Reenlistment and Promotion Analyses

➢	**Demographic Characteristics**
◆	Date of Birth
◆	Gender
◆	Race/Ethnicity
◆	Marital Status *
◆	Military Spouse *
◆	Number of Dependents *
◆	Education Level *
◆	State of Legal Residence *
➢	**Aptitude At Accession**
◆	AFQT Score/Percentile
◆	Education Level
➢	**Enlistment/Reenlistment Contract**
◆	Term of Enlistment/Reenlistment *
◆	Army College Fund (ACF) "Kickers"
◆	Montgomery G. I. Bill Eligibility
◆	Date of accession
◆	Date of reenlistment *
➢	**Military Job Characteristics**
◆	MOS *
◆	Major Command *
◆	Unit Identification Code (UIC) *
◆	Pay grade *
◆	Date of separation
◆	Date of pay grade (promotion) *
◆	Selective reenlistment bonus (SRB) multiple
➢	**Satisfaction with Military Life**
◆	Satisfaction with PERSTEMPO
◆	Intention to Reenlist
◆	Other Satisfaction Measures
➢	**Career Attitudes**
◆	Career intentions at accession and end-of-training
◆	Education aspirations at accession and end-of-training
◆	Expectations regarding timing of next promotion
◆	Military versus civilian pay and benefits
◆	Other attitudinal measures
➢	**Access to ACES**
◆	OCONUS/CONUS *
◆	Installation has an education/learning center *
◆	Member Works Extra Job
➢	**ACES Participation**
◆	Self-Reported Continuing Education
◆	TA for undergraduate courses *
◆	Courses in SOCAD schools *
◆	2/4 year SOCAD Agreements *
◆	FAST Program *
◆	MOS Improvement Courses *
◆	NCO Leader Development Courses *
➢	**Economic Factors**
◆	Unemployment rate (based on Bureau of Labor Statistics data) *

An asterisk indicates fluid, time-varying, variables.

A common unique person identifier, such as Social Security Number (SSN), must be present in all evaluation data, so that information from the different data sources can be merged. Finally, in order to capture the full effect of variables that change over time, data sources must provide longitudinal data on time-varying soldier demographic (including educational) and military job characteristics. A summary of these requirements is provided below:

- the combined data sources must provide all the variables required by the evaluation plan;

- the data source(s) must contain data on the populations specified in the evaluation plan during the appropriate time periods;

- the data source(s) selected must be the most cost- and labor-efficient alternative(s) of its genre, all other factors being equal;

- the data source(s) for objective education data must result in complete education participation data for all soldiers;

- all data sources must contain a common link variable (such as SSN); and

- all time-varying data of interest must be available longitudinally.

Data Sources

A discussion of data sources for the types of data of interest to this evaluation study – education participation, administrative, self-reported education and attitudinal, and economic – is provided below.

ACES Participation Data

There are two sources of electronic education participation data describing the programs that are included in the evaluation plan: EDMIS and the SOCAD Student Agreement databases.

EDMIS. ACES participation data are stored electronically as an Oracle relational database[55] called EDMIS.[56] Since EDMIS is designed for distributed rather than centralized computing, the database is populated and maintained at installation education/learning centers.[57] The structure and format of EDMIS databases are the same regardless of the installation site. Beginning in 1995, six CONUS facilities had EDMIS software installed for pilot testing. By

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[55] Oracle is a corporation that produces a number of software products. A relational database is a database management system that stores data in tables and links tables through the use of key variables. The Oracle system, one of a number of relational database management systems available, makes it very easy and efficient to link data from multiple tables.

[56] The Directorate of Information Systems, Communications Command Control and Computers provides funding and staffing of all Information System Modules (ISMs) of which EDMIS is a part.

[57] EDMIS, like all other ISMs, is housed on installation servers, which may be tapped by more than one facility. For example, one server is used by all European Army bases.

1997, all CONUS installations with an education/learning Center were using EDMIS. Nearly all sites had EDMIS installed by the end of calendar year 1998.[58]

The ACES participation history of a soldier is recorded in the EDMIS database of the facility at which the soldier is stationed at the time the participation occurs. When a soldier is assigned to a new station, information on educational activity occurring from that point in time until the next assignment is stored in the new station's EDMIS database. As stated previously, there is no centralized repository of EDMIS data. In order to obtain complete ACES participation data for a soldier, the EDMIS data from each facility in which the soldier was located must be retrieved. ACES participation data prior to January 1999 are incomplete for soldiers who moved from an EDMIS-installed facility to a non-EDMIS installed station. Even if the evaluation focused only on those soldiers who moved between EDMIS-installed facilities prior to 1999, the results may be tainted by factors related to the selection of sites for EDMIS installation, such as MOS or unit type. This non-random sample would likely over-represent certain types of soldiers, such as those assigned to CONUS facilities. Therefore, in order to be assured that educational participation data are complete, data must be culled from all EDMIS-installed sites from January 1999 forward.[59]

Although planned for the future, ACES data have not been archived to date. Although EDMIS data can be purged by the installation based on business necessity, it appears that no EDMIS data have been purged to date. Therefore, data are available on-line since the date of EDMIS installation at each facility.[60] Since EDMIS is a relational database, variables are stored in tables that can be merged with one another by unique link (or key) variable(s). In addition, EDMIS is linked to the site specific Installation Level Integrated Database (ILIDB) which contains data from the installations' personnel database.[61] The EDMIS *Installation Support Module Database Design Description* provides a list of data elements contained within EDMIS tables. Currently, there is no EDMIS codebook containing detailed variable descriptions and value definitions. A number of EDMIS tables or variables within tables are not consistently used at installations and, therefore, have been deemed unreliable by EDMIS experts at PERSCOM.[62]

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[58] Ten sites had EDMIS installed in calendar year 1998; of these, four OCONUS sites (Europe; Camp Zama, Japan; Okinawa; and Korea) began using EDMIS in the 1st quarter of FY 1999. EDMIS was installed in Ft. Buchanan as recently as September 1999. As of 1 September 2000, there are seven sites without EDMIS: West Point; Dugway Proving Ground; Charles Melvin Price; Selfridge; Yuma Proving Ground; Ft Hamilton; and Ft. Dix.

[59] Although the main analyses will be conducted on ACES participants as of January 1999, the evaluation plan calls for collecting EDMIS data starting in January 1998 – the earliest cohort date – so that validation analyses may be conducted.

[60] Hard copy records maintained prior to EDMIS installation were input into EDMIS at some sites.

[61] The Standard Installation/Division Personnel System 3 (SIDPERS3) is the Army's operational personnel database installed and maintained at the installation-level. It is linked to the ILIDB and then to EDMIS.

[62] For example, all EDMIS tables pertaining to the Army Personnel Testing Program (APTP) are inconsistently populated at the sites. The SOCAD tables (SOCAD, SOCAD_OTH, and SOCREF) have also been deemed unreliable because they are not consistently used. The tables pertaining to counseling do not distinguish educational counseling from other types of counseling and are not consistently populated at the sites. Of a total of 68 tables in

Although potentially flawed, EDMIS is the only source of automated objective (non-self-reported) data on participation in continuing education. At this time, we do not know the quality of the EDMIS data in which we are interested for the evaluation. The only other potential source of objective data is hardcopy records, which may not exist, and which would present even greater coding problems. Although we wish that the EDMIS data were more amenable to statistical scrutiny, the fact is that EDMIS is the only feasible choice of objective participation data for the evaluation.

SOCAD Student Agreement Data. Soldier-level data on SOCAD contracts have been maintained by the Servicemembers Opportunity Colleges (SOC) since the program began in the 1980s. The data are stored in two databases called SOCAD-2 and SOCAD-4 that contain soldier-level data on 2- and 4-year SOCAD contracts, respectively. Data are sent from SOCAD schools on a quarterly basis and are key-entered manually.[63] These databases contain data on the SOCAD schools attended and the date of the SOCAD agreements.[64] These data do not contain information on courses taken or degrees received. The file may contain multiple records per soldier since soldiers can enter into 2- and 4-year SOCAD agreements and may also update existing agreements.[65]

Administrative Data

Administrative data describing soldier demographic attributes (e.g., gender, race, marital status) and military occupational characteristics (e.g., enlistment term, MOS, separation program designator) are recorded in a number of databases. The origin of all these data, in some part, can be traced to the Standard Installation/Division Personnel System 3 (SIDPERS3) or a predecessor to SIDPERS3.

SIDPERS3. SIDPERS3 is the Army's operational personnel database installed and maintained at the installation-level. SIDPERS3 provides a snapshot of the characteristics of servicemembers at each Army station at a particular point in time. Although some variables are stored in a way that supports longitudinal analysis,[66] SIDPERS3 data are not longitudinal. In its

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the EDMIS database, 24 (35%) were of initial interest to this evaluation. Of these, 12 (50%) were deemed unreliable by PERSCOM and an additional 4 (17%) were determined either to contain information duplicated in other tables or to be difficult to query. In general, the quality of the remaining selected EDMIS data is currently unknown.

[63] The error rate has been determined for some fields to be between 1% and 2%. The error rate for SSN is unknown. In addition, rank at the time of the SOCAD agreement is missing approximately 33% of the time.

[64] Unfortunately, the SOCAD date field may contain either the date of the SOCAD agreement or the date that the information was entered on to the SOCAD-2 and SOCAD-4 databases.

[65] The evaluation study will collect all available SOCAD data regardless of date, since once a SOCAD agreement is in place, it exists until it is amended or a degree is earned.

[66] For example, SIDPERS3 allows for recording more than one Armed Forces Classification Test (AFCT) score. The AFCT is an in-service test that evaluates individuals on the same 10 aptitude areas as the enlistment Armed Services Vocational Aptitude Battery (ASVAB). Although there is a "place" for more than 1 AFCT score, these scores are not routinely input into SIDPERS3.

normal operational use, the values of many SIDPERS3 variables are systematically overwritten with updated information. In addition, SIDPERS3 data are not systematically archived, so that there is no historical view of SIDPERS3 "snapshots." Also, because SIDPERS3 is an operational, installation-level database, there appears to be a greater amount of data inconsistency between facilities than one might find in a more centralized system.[67]

Total Army Personnel Database (TAPDB). Installation-level SIDPERS3 data are transmitted daily to PERSCOM, where they are "cleaned" and, in some cases, modified (e.g., recoded) for inclusion in the TAPDB, the centralized personnel database for the Army.[68] The TAPDB contains standardized data across Army components. It is composed of Active Enlisted, Active Officer, Reserve, and National Guard data. TAPDB is currently a CA Datacom mainframe database[69] that is being converted to an Oracle relational database on a client server platform. Like SIDPERS3, the Active Enlisted data file in the TAPDB, called the TABDB-AE, contains information on enlisted soldiers who are current Army servicemembers. Soldiers who separate from the Army are moved out of the TABDB-AE to the TAPDB Reserve file 120 days after separation[70]. Because data are systematically overwritten with updated information[71], the TAPDB itself is not longitudinal. Nor is there a formal, complete archive of the TAPDB itself, although a subset of TABDB-AE data that is retrofitted to look like the Enlisted Master File (EMF), the Army's enlisted personnel database prior to TAPDB, is archived at PERSCOM.[72] In addition, TAPDB data extracts are transmitted to other government organizations – such as the Defense Manpower Data Center (DMDC) and the Army Research Institute (ARI) - who then routinely archive those extracts.

DMDC Active Duty Master and Loss Files. Directed by DODI 1336-5, PERSCOM transmits selected TAPDB data elements to the DMDC on a monthly basis.[73] In the past, in order to conform to DOD-wide standards, DMDC would recode certain variables and add others to the data received from PERSCOM. Since September 1999, however, the data received from the services must conform to DOD-wide standards prior to transmittal to DMDC. DMDC archives

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[67] This observation is based on conversations with PERSCOM TAPDB specialists on 23 March 2000.

[68] While SIDPERS3 is the primary input to TAPDB, there are a number of others. For example, the Army Recruiting Accession Data System (ARADS) provides the initial recruiting information on soldiers to the TAPDB.

[69] CA Datacom is relational database software developed by Computer Associates for use on mainframe computers.

[70] The Reserve File, maintained in St. Louis, records soldier attributes at the time of separation.

[71] Like SIDPERS3, some TAPDB variables are stored in a way that makes longitudinal analysis possible. For example, TAPDB maintains data on a soldier's last 20 job assignments. However, other variables, such as education level, are overwritten.

[72] There are 10 years of monthly EMF data archived at PERSCOM. It is unclear whether a current codebook exists for the EMF.

[73] PERSCOM TAPDB data that are transmitted to DMDC are cut mid-month. PERSCOM then spends about two weeks cleaning the data. These data are then transmitted to DMDC by file transfer protocol (FTP) by around the first of the following month. Servicemember loss information is transmitted to DMDC on a weekly basis.

each month's [74] "snapshot" from the TAPDB, effectively creating a longitudinal database in the process. These data are called the Active Duty Master and Loss Files (ADMLF). Stringing closely timed TAPDB "snapshots" together creates a longitudinal database where changes occurring in soldier attributes over time are observable.

Military Entrance Processing Command (MEPCOM) data are matched to TAPDB data by DMDC. Soldiers appear in the DMDC Active Duty Master File in the archive months during which they are on active duty. Once a soldier separates, his or her record is dropped from that month's Master data and appears in the DMDC Loss File.

DMDC Cohort File. There are a number of DMDC files that are based in whole or in part on the ADMLF. One such file that has been used repeatedly in previous ARI research is the Active Duty Military Enlisted Cohort File. The Cohort file is composed of an accession year cohort as identified by the MEPCOM Examination and Accession File. It is then matched on a yearly basis with fiscal year-end ADMLF data to track individuals' military careers. The Cohort file basically consists of four blocks or types of data. The first block contains MEPCOM accession data, such as the AFQT score and entry date. The next block consists of information extracted from a match to the Master or Loss File, whichever is the most recent. Therefore, if a soldier is active, the "most recent" block will contain selected variables from the most recent Master File; if a soldier has separated, data in the "most recent" block in the Cohort File will come from the Loss File. The third Cohort block of information records data from the second most recent match to either the Master or Loss File. Finally, the fourth block contains data from the first Loss File match, where applicable. Although it provides active duty information at two or three points in time (most recent, second most recent, and first loss), the Cohort file is not longitudinal. Since the Cohort file only includes recent (most and second most recent) Master/Loss data, more longitudinal information is lost as soldier tenure increases.

EMF. A quarterly EMF, which is transmitted to ARI, contains a subset of variables found in the larger PERSCOM-maintained EMF discussed above. The "ARI EMF" is transmitted as a flat file, which is read, processed, and archived by ARI. Taken in aggregate, the quarterly archives of the "ARI EMF" data provide longitudinal information on soldier attributes and military job characteristics.

ARI Special Attrition Databases. The First Tour Attrition Database, based on the FY 1992 DMDC Cohort File, was constructed for ARI in 1998 as a prototype database for the study of attrition. A subsequent ARI attrition project has resulted in the development of an extensive database on the FY 1999 accession cohort of enlisted soldiers ("Project First-Term"). The data in this 1999 attrition study are current as of December 1999 and there are plans to update these data through the end of FY 2003. The Project First-Term data are especially rich in administrative and attitudinal data. Both attrition databases contain quarterly EMF data, providing longitudinal information on cohort members.

DMDC Special Cohort and Continuer Files (DSCAC). The DSCAC data are based on fiscal year accession cohorts and contain data that track the careers of active duty enlisted

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[74] Monthly data are archived from December 1992 to the present; quarterly data are available since June 1975.

servicemembers, including soldiers with prior service, who enter the military through the MEPCOM. Using MEPCOM and ADMLF data, an individual is tracked quarterly for the first four and a half years and then every six months until the soldier has been followed for 20 years (or through the most recent file). Hence, the DSCAC data are longitudinal. Each record contains four main blocks of information: (a) MEPCOM accession data, (b) first loss information, (c) active duty data representing a snapshot of the soldiers' career status at a given point in time, and (d) DMDC-constructed "flag" information which makes the files easier to use. The DSCAC database currently contains data on 20 separate cohorts, beginning in 1978 through 1997.

The Active Duty Personnel Edit File (PEF). The PEF is also based on the ADMLF, but is created by DMDC on an ad hoc basis. Based on a data request like that for this evaluation study, DMDC can extract the population and data elements of interest and can provide "snap-shots" of soldier attributes on a monthly, quarterly, or year-end basis, or whenever a change in a specified variable (e.g., pay grade) occurs. PEF data are, therefore, longitudinal.

Defense Enrollment Eligibility Reporting System (DEERS). The DEERS database contains one record for each servicemember whether on active duty for more than 30 days, retired, or a member of the Reserve component. DEERS also contains a record for each of the servicemember's family members. Servicemember and family data include: (a) personal data, such as SSN, date of birth and gender; (b) service-related information, such as service and unit identification code; (c) geographic data, and (d) information on benefits, such as Montgomery GI Bill (MGIB) education benefits.

Self-Reported Education and Attitudinal Data

There are two sources of self-reported education and attitudinal data: the Survey of Active Duty Personnel (SADP) and the Sample Survey of Military Personnel (SSMP).

SADP. This survey is administered to a stratified random sample of DoD members approximately every four years. The 1999 survey was administered between September 1999 and January 2000 and asks soldiers to report whether in the past 12 months they participated in (a) adult continuing education or counseling, (b) tuition assistance programs for college, (c) technical or vocational programs, and/or (d) a basic skills education program. The survey contains information regarding the intentions of soldiers to remain in the military, their satisfaction with off duty educational opportunities, primary reasons why the member joined the military (e.g., for education benefits and opportunities), and other demographic and job related characteristics that are of interest to this evaluation. While the 1999 SADP collected SSN from respondents, the survey data will not be released containing SSN for reasons of confidentiality and data security. There is currently no codebook available describing 1999 SADP data elements.

SSMP. The SSMP containing ACES participation data is administered by ARI to a random sample of Army enlisted soldiers and officers every two years. The survey contains such items as satisfaction with military life and education level and intention to reenlist, as well as questions about participation in ACES programs. Unlike the SADP, the SSMP is anonymous, in that no unique soldier identifier, such as SSN, is collected by the survey.

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Economic Data

The Bureau of Labor Statistics (BLS) publishes information on unemployment rates and pay and benefits. This information is readily available on the BLS website.

Evaluation of Data Sources

What are the optimal sources of data for the study described in the evaluation plan? A discussion of the "goodness of fit" between the evaluation study requirements and the characteristics of the data sources considered is provided below.

ACES Participation Data. The EDMIS and SOCAD contract data are the only electronic data sources on objective education participation in the programs of interest to this evaluation. As such, they are key data sources in the evaluation study data development plan. Selecting education participation from January 1999 forward for the main analyses and eliminating soldiers who were in sites that did not have EDMIS installed by that date[75] satisfies the criterion of data completeness. The further requirement of the availability of longitudinal time-varying data is also satisfied by EDMIS and SOCAD because historical data are currently available on-line or will be available in archive in the future. In addition, these data contain SSN, satisfying the requirement for a common link variable.

Administrative Data. Three sources of administrative, demographic, and military career data can be eliminated from further consideration because they do not contain longitudinal data for time-varying attributes: SIDPERS3, TAPDB, and the DMDC Cohort file. The DMDC ADMLF can also be eliminated because it does not satisfy the criterion of efficiency. The sheer number of monthly files and the fact that the Master and Loss components of the ADMLF are physically distinct files that must be combined to obtain full career histories, will make working with the ADMLF cumbersome and inefficient, particularly in the face of more attractive alternatives.

Neither the DSCAC nor the Cohort data meet the criterion of efficiency for the reenlistment and the promotion analyses. This is because the DSCAC and Cohort files are based on accession year cohorts, whereas the retention and promotion analyses will be conducted on event-year cohorts – the year in which an event occurred (i.e., promotion) or is scheduled to occur (i.e., ETS). Substantial time and effort are required to identify an event-based cohort from accession-based cohort data.

The 1992 First Tour Attrition Database does not provide data on the populations specified in the evaluation plan and is, therefore, eliminated from further consideration. Because complete EDMIS data are available starting in January 1999, educational participation data are available about seven years into the careers of the 1992 First Tour Attrition Database cohort. By that time, most soldiers are either separated or well into their second tour of service. Therefore,

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[75] To ensure complete EDMIS data for all cases, soldiers who were ever assigned to any of the seven sites that currently do not have EDMIS installed or Ft. Buchanan, where EDMIS was installed in September 1999, will be eliminated entirely from the evaluation study.

the 1992 First Tour Attrition cohort is too old for purposes of this evaluation. On the other hand, while the Project First-Term cohort is somewhat too young to measure first term attrition, it is an extremely rich source of data for observing early attrition and reclassification. The only required variable that is missing from the Project First-Term data is MGIB.

The EMF (both the ARI and the larger PERSCOM EMF) and the PEF contain longitudinal data on the populations of interest to this evaluation. Because the EMF and PEF data are both based on snap-shots of the force at given points in time, the level of effort required to identify cohort members and extract their data are very similar.[76] While the PEF contains all the variables required by the evaluation plan, the "ARI EMF" lacks a critical variable – the unit identification code (UIC). The "ARI EMF" can, therefore, be dropped from further consideration.

The remaining two administrative data sources are attractive candidates for identifying members of the reenlistment and promotion cohorts. There is currently no reason to believe that costs associated with preparing the data for analysis (e.g., data cleaning, recoding, diagnostics) will differ substantially for data extracted from the larger EMF and those culled from the PEF. The EMF contains data on the MGIB, a static variable, which the PEF lacks. However, this information could be obtained from DEERS for the attrition/reclassification and reenlistment cohorts.[77] Both the EMF and the PEF/DEERS could be used to supply the administrative data for the reenlistment and promotion analyses. However, whereas DMDC produces ad hoc files routinely and is, therefore, experienced in filling non-standard data requests, PERSCOM does not often fill non-routine data requests from the EMF.[78] Therefore, for reason of efficiency, we recommend using PEF/DEERS data as the source for administrative data on demographic attributes and military characteristics for the reenlistment and promotion analyses. In addition, DEERS can be used to supply MGIB to the Project First-Term data.

What frequency of data "snap-shots" is sufficient to provide a longitudinal perspective of servicemember careers and behavior? The types of time-varying variables of interest to the evaluation study – such as marital status, number of dependents, MOS, pay grade – typically do not change routinely or often. Monthly snap-shots are probably too frequent, while annual files are not frequent enough. Therefore, data consisting of quarterly snap-shots over the observation period are recommended. In terms of the early attrition and reclassification analyses, the plans for Project First-Term data already include quarterly EMF updates through FY 2003. We recommend quarterly PEF data for the reenlistment and promotion cohorts.

Self-Reported Education and Attitudinal Data. Although the SSMP collects self-reported education participation data and attitudinal measures, its lack of respondent SSNs precludes its

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[76] As discussed above, the level of effort required to identify event year cohort members is substantially less from "snap-shot" files like the EMF and the PEF than for accession year based files like the Cohort file.

[77] MGIB data is not relevant for the promotion analyses.

[78] This observation is based on conversations with Alex Schneider and Don Edwards, Requirements Team, Plans Branch, PERSINSD, PERSCOM.

linkage to any other data. The SADP is the only known source for attitudinal measures and self-reported education that requests SSN from respondents. In addition, it was administered at approximately the period of time that is appropriate to the evaluation study.[79] Since SADP SSNs will be withheld from evaluation study contractors for reasons of confidentiality and privacy, a strategy of encrypting SSNs, described in a later discussion, has been developed to circumvent this issue.

In summary, the following soldier-level data sources have been selected for the ACES evaluation study:

- EDMIS for ACES participation data,

- SOCAD-2 and SOCAD-4 for data on SOCAD Student Agreements,

- PEF/DEERS for administrative demographic and military data for the reenlistment and promotion/reclassification cohorts,

- Project First-Term/DEERS for administrative demographic and military data for the early attrition/reclassification cohorts, and

- SADP for attitudinal and self-reported education participation data.

Table 4 presents a summary of the limitations of the rejected data sources by the data requirement criteria discussed above. Because all sources of automated education participation data of interest have been selected (i.e., EDMIS and SOCAD-2 and -4), the requirement for complete education data is not included in Table 16.

Table 16
Table of Limitations of Rejected Data Sources by Data Requirement Criterion

Data Sources	Data Requirement Criterion				
	Required Variables	Relevant Population(s)	Most Cost/Labor Efficient of Genre	Common Link Variable	Longitudinal Time-Varying Data
SIDPERS3					X
TAPDB					X
ADMLF			X		
DMDC Cohort			X		
"ARI EMF"	X				
"PERSCOM EMF"			X		
1st Tour Attrition Database		X			
DSCAC			X		
SSMP				X	

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[79] Because the exact date that individual respondents took the SADP is unknown, only criterion measures occurring after January 2000 (the latest administration date for the 1999 SADP) can be analyzed using explanatory measures from the 1999 SADP.

Producing an Evaluation Analytic Database

Overview of the Data Collection Process

Data Encryption. One of the first steps in building an evaluation analytic database is to identify cohort members. DMDC will identify the reenlistment and promotion cohorts from the PEF administrative data and extract their PEF/DEERS data. Once the data are obtained, the contractor will assess whether the cohorts appear to be correctly identified.[80] Next, MGIB from DEERS data must be produced for the Project First-Term cohort.

Because of confidentiality issues with the 1999 SADP, special care will be taken to strip SSNs from data provided to the evaluation contractor that will be linked to the SADP. DMDC will encrypt the SSN of each member of the reenlistment and promotion cohorts and will provide the contractor with the PEF/DEERS data identified with the encrypted, rather than unencrypted, SSNs. In addition to this PEF/DEERS data, DMDC will create electronic ASCII files containing only two data elements: the encrypted and unencrypted SSNs of the reenlistment and promotion cohort members. DMDC will transmit a copy of these electronic files to the evaluation project COTR. The COTR will, in turn, send a copy of these files containing the SSNs to the appropriate POCs for matching to EDMIS and SOCAD data on the basis of unencrypted SSN. The parties responsible for matching cohort members' unencrypted SSNs to the EDMIS and SOCAD data will be asked by the project COTR to drop the unencrypted SSN from the data returned to the contractor and include only encrypted SSN as the unique identifier. DMDC will also apply the same encryption formula to the 1999 SADP and provide the contractor with the survey data and encrypted SSN. Since the Project First-Term cohort will not be linked to the SADP, EDMIS data will be obtained for the cohort members by SSN.

Once data cleaning and manipulation are completed (see below), the EDMIS and SOCAD data can be merged to PEF/DEERS by encrypted SSN and to Project First-Term/DEERS by unencrypted SSN to form preliminary analytic databases. The SADP data form the remaining main cohort. The SADP cohort will be merged with the reenlistment and promotion cohorts on the basis of encrypted SSN to form the intersected cohorts described above.[81]

Although the project COTR will provide the encrypted and unencrypted SSNs to the appropriate parties for obtaining EDMIS and SOCAD data, the contractor must provide detailed specifications of the data required. Specifications for obtaining the evaluation study data are presented below. Access to Project First-Term data is rather straightforward and involves a simple authorization from ARI for use of the data. For this reason, data request specifications for Project First-Term data are not provided here.

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[80] This assessment can be made by generating frequency distributions or crosstabulations on those variables that define the cohort.

[81] This encryption strategy is fairly complex and somewhat onerous. However, if SADP confidentiality requirements remain unchanged and the SADP must be linked to other data sources, this approach is reasonable. If confidentiality requirements are relaxed or the SADP is analyzed as stand-alone data, this encryption strategy can be greatly simplified or eliminated entirely.

PEF/DEERS Data Specifications. DMDC requires a written memorandum by the organization requesting data stating the specific data file(s) of interest, the use that the data will be put to, confidentiality and security precautions that will be undertaken, the population and variables needed, and any special instructions or requirements. DMDC requires approximately 6 weeks to produce ad hoc PEF files based on non-accession year cohorts.

EDMIS Data Specifications. The DMDC PEF/DEERS and the Project First-Term/DEERS data will define the observations for which EDMIS data will be extracted. As stated above, the encrypted and unencrypted SSNs from the PEF/DEERS will be provided to the designated EDMIS POC[82] by the project COTR for the extraction of EDMIS data. The SSNs from the Project First-Term cohort will also be provided to the designated EDMIS POC.

SOCAD-2 and SOCAD-4 Data Specifications. Like EDMIS, the encrypted and unencrypted SSNs from the PEF/DEERS and the SSNs from the Project First-Term cohort will be provided to the designated SOCAD POC[83] by the project COTR.

SADP Data Specifications. As noted above, the SADP defines its own cohort in the evaluation study.

Procedures for Creating an Evaluation Analysis File

Data Diagnostics and Cleaning. Statistical Analysis System (SAS) or the Statistical Package for the Social Sciences (SPSS) system files should be created for all evaluation study data. First, the contractor conducting the evaluation will review all documentation accompanying the data. Second, in order to become familiar with the data, the contractor will conduct a preliminary review of univariate statistics (frequency distributions for discrete variables and means/standard deviations for continuous data elements) of all data. Third, based in part on the review of univariate statistics, the contractor will clean and edit the data. Careful attention should be paid to the coding of missing values. For example, some DMDC data elements are coded 0 to indicate missing data. Since the evaluation data will be subjected to statistical scrutiny, cases with numerically coded missing data must be recoded to system missing values. Variables whose values fall outside the acceptable range will be identified and "cleaned". The logical consistency between variables will be assessed. This can be done through a series of cross-tabulations and

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[82] There are a number of unknowns at the time of this writing regarding the procurement of EDMIS data. First, the specific individual or individuals at PERSCOM who will be responsible for obtaining EDMIS data have not been identified. Second, although it is clear that the contractor conducting the evaluation study will not have hard-wired or network access to EDMIS data, the process by which the information will be obtained is otherwise also unknown. The most recent information indicates that EDMIS data requests made by the contractor may be forwarded by PERSCOM to individual education centers that will be responsible for the processing of that information. Third, the form that the request for data should take is also unclear. The assumption here is that a written request for data is sufficient. Since they will not have access to the data, the contractor' s role in this process is limited to requesting data rather than procuring it. Hence, the relative merits of one strategy of data procurement over another could not be ascertained.

[83] Information obtained from SOC indicates that the request for data should be sent to PERSCOM, which will forward the request to SOC for fulfillment. The specific individual at PERSCOM who will receive and forward the request has not been identified as of the time of this writing.

programming statements designed to isolate the relationship of two or more variables. Skip patterns in the SADP will be identified and checked to ensure that the electronic data reflect the established patterns of response in the survey. All edits will be checked to ensure that the desired changes have been made. Finally, all edits to data will be made programmatically, rather than interactively, and all programs must be retained for purposes of documentation. All variables will be assigned value labels or formats to facilitate ease of use.

Data Structure. Once the data have been cleaned, the issue of the structure of the evaluation data can be addressed. Data from the PEF/DEERS, Project First-Term/DEERS, and the SADP contain one record per soldier. EDMIS data may contain multiple records for an individual soldier within a facility and the soldier may appear in the EDMIS records from many facilities. The combined SOCAD-2 and -4 data may also contain more than one record per soldier. The goal for statistical processing is to arrive at a file for each type of analysis (early attrition, reenlistment, reclassification, and promotion) that contains a single record per soldier.

EDMIS data can be combined with SOCAD data to form a data file containing education participation for all ACES programs of interest.[84] Because the criterion measures must always post-date the explanatory variables, education participation must always occur before the early attrition, reenlistment, reclassification, or promotion being analyzed. One way to ensure that the education participation variables are temporally correct for a particular criterion is to merge the PEF data containing the date of the criterion of interest with the combined EDMIS/SOCAD data containing multiple records per SSN across all facilities. The date of the criterion measure can then be compared to the date of the education participation, and only the temporally correct education records can be retained. Those "correct" EDMIS records can then be combined to form a single record containing blocks of data arranged chronologically describing education participation during the observation period of the criterion. This single EDMIS record must then be merged to the full set of administrative PEF/DEERS and Project First-Term/DEERS data. It must be remembered that the temporally correct education participation must be identified for each criterion measure analyzed.[85]

Variable Coding. Because codebooks are not available for the SADP, EDMIS, and SOCAD-2 and 4 databases, a discussion of the coding of analysis variables is not possible for these data.

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[84] If necessary, EDMIS data from all facilities will be concatenated to form a total EDMIS database. The EDMIS and SOCAD data can then be combined so that the resultant file contains both EDMIS and SOCAD variables; the records from EDMIS will contain missing data for the SOCAD data elements and vice versa. Variables can then be created that store analytically relevant data from the EDMIS and SOC portions of the record. An example of analytically relevant variable construction is the creation of a variable "DATE " that assumes the value of a course date for EDMIS records and the SOCAD agreement date for SOC records. Essentially this combined file simulates the EDMIS data if it had contained reliable SOCAD data. This combined file can then be sorted by SSN and date. The resultant file will contain education participation data from all facilities with multiple records per soldiers in chronological order.

[85] There are other ways to achieve the same goal. For example, a single soldier EDMIS record can be created at each site and then merged together to form one comprehensive record. Once merged with PEF data, the temporally correct blocks of data on this comprehensive record can then be identified with some elegant array processing.

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Summary

The purpose of this data development plan is to ensure a sound and successful evaluation by meeting all its data needs. The data development plan first identifies the data and population requirements set forth in the evaluation plan. Next, all relevant data sources are reviewed in light of these requirements. Third, an assessment of the "goodness of fit" between data characteristics and these requirements is presented. This assessment results in the selection of databases for the evaluation study. Finally, a discussion is presented on procedures for building the evaluation database, including data encryption, data requests/specifications, diagnostics, data editing, database structure, and variable coding.

SUMMARY AND CONCLUSIONS

Although past research investigated a limited number of CE programs, the results of this research identified potentially substantial beneficial effects of military voluntary education programs on retention and performance. These results also affirmed the importance of considering selection bias in any evaluation of CE programs because the individuals who participate in these programs tend to be better qualified and more highly motivated than those who don't participate. In addition, previous studies identified many of the other explanatory factors that should be included as control variables in an evaluation of ACES to avoid misleading results.

The evaluation and database development plans contained in this report provide a procedure to determine whether the effects found in previous research studies occur for the Army's ACES program, as well. The plans build on the results of past research to isolate the effects of participation in ACES programs from the effects of other potentially confounding variables. They also consider limitations on the availability, accuracy, and completeness of participation and outcome data that make a comprehensive evaluation of these programs difficult.

The evaluation plan addresses the following five ACES programs: (a) TA, (b) SOCAD, (c) FAST, (d) MOS Improvement Courses, and (e) NCO Leader Development Courses. The design of the plan is based on a conceptual framework that allows one to derive hypotheses regarding the direct and indirect effects of the selected programs on early attrition, reenlistment, promotion, and MOS reclassification. The analysis planned for each outcome measure is based on a specific conceptual model that enumerates and organizes the explanatory factors that contribute to the outcome being assessed. This model, along with the results of previous research, specifies the form of the analysis and the variables to be incorporated in it. By incorporating variables that predict ACES participation into the analysis, the plan reduces the effects of selection bias on the obtained results.

One on the obstacles that needed to be overcome in the development of the plan was the limited availability of participation data. Addressing this limitation required the specification of several analysis cohorts, each designed to support the evaluation of the effects of particular ACES programs on one or two outcome measures. Use of multiple cohorts necessarily increases the effort required to obtain, test, structure, and analyze data. However, it allows the effects of ACES programs on all relevant outcome measures to be assessed using objective participation data that is only available for the most recent years.

Implementing the evaluation plan will require overcoming several challenges. The primary difficulty will be the obtaining and structuring data from EDMIS regarding participation in ACES programs. Because EDMIS is maintained independently at more than 130 Education Centers, and because the system is an operational database that is not designed to support statistical analyses, developing the analytical database for the evaluation will require considerable effort and expense. The database development plan contained in this report anticipates some of the problems that may arise, but it is likely that other unanticipated problems will occur when the database is actually built.

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Alternative approaches have been considered to reduce the effort required for database development and to circumvent some of the risks of error or inconsistencies in the obtained participation data. Some of these approaches are the following:

- Conduct analyses at selected bases that represent a cross section of Army personnel, thus reducing the potential for inconsistencies between sites.

- Reducing the number of variables obtained from EDMIS to the minimally required variables. This reduction would still allow us to conduct the major analyses included in the plan but would eliminate the possibility of conducting ancillary or exploratory analyses.

- Increase the use of data sources that include self-report participation measures, such as the SADP or the SSMP.

- Conducting a relatively small preliminary analysis designed solely to determine the viability of using EDMIS data for the evaluation effort. The results of this analysis would provide recommendations about the quality of EDMIS data and the effort required to format the data for analysis.

We recommend that the process of developing alternative approaches that may be more cost effective continue. However, these approaches should be based on the general guidance provided by the conceptual models described in the evaluation plan.

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APPENDIX A

SEPARATION CODES

Separations Coded as "Voluntary Separations prior to ETS"	Separations Not Considered to Be Attrition		Involuntary Attrition and other Separations excluded from the analysis
	Separations Coded as a Decision to Reenlist	Separations Coded as a Decision Not to Reenlist	
early release, insufficient retainability	officer commissioning program	early release, to attend school	condition existing prior to service
unqualified for active duty, other	warrant officer program	early release, police duty	disability
failure to meet weight or body fat standards	military service academy	early release, in the national interest	dependency or hardship
character or behavior disorder	immediate reenlistment	early release, seasonal employment	death
motivational problems		early release, to teach	enuresis
good of the service (discharge in lieu of court-martial)		failure to meet minimum qualifications for retention	retirement
alcoholism		voluntary release, to attend school or to teach	minor (underage)
discreditable incidents		voluntary release, in the national interest	voluntary release, other, including VSI and SSB
shirking		ETS	early release, other, including RIF, VSI, and SSB
drugs			
financial irresponsibility			
lack of dependent support			
unsanitary habits			
civil court conviction			
security			
court-martial			
fraudulent entry			
AWOL or desertion			
homosexuality			
sexual perversion			
inaptitude			
juvenile offender			
misconduct, reason unknown			
unfitness, reason unknown			
unsuitability, reason unknown			

Separations Coded as "Voluntary Separations prior to ETS"	Separations Not Considered to Be Attrition		Involuntary Attrition and other Separations excluded from the analysis
	Separations Coded as Decision to Reenlist	Separations Coded as a Decision Not to Reenlist	
pattern of minor disciplinary infractions			
commission of a serious offense			
unsatisfactory performance			
entry level perform and conduct			
secretarial authority			
erroneous enlistment			
sole surviving family member			
marriage			
pregnancy			
conscientious objector			
parenthood			
breach of contract			
other			
immediate reenlistment			
dropped from strength, desertion			
dropped from strength, imprisonment			
involuntary release, convenience of the government			

APPENDIX B

LIST OF ACRONYMS

Acronym	Definition
AARTS	Army/American Council on Education Registry Transcript System
ACES	Army Continuing Education System
ACF	Army College Fund
ACT	American College Test
ADMLF	Active Duty Master and Loss Files
AFQT	Armed Forces Qualification test
APTP	The Army Personnel Testing Program
ARI	Army Research Institute
BLS	Bureau of Labor Statistics
BSEP	Basic Skills Education Program
CCAF	Community College of the Air Force
CE	Continuing Education
CLEP	College Level Examination Program
CONUS	Continental United States
CY	Calendar Year
DANTES	Defense Activity for Nontraditional Education Support
DEERS	Defense Enrollment Eligibility Reporting System
DMDC	Defense Manpower Data Center
DoD	Department of Defense
DPS	Deterrents to Participation Scale
DSCAC	DMDC Special Cohort and Continuer Files
EDMIS	Education Management Information System
EMF	Enlisted Master File
ESL	English as a Second Language
ETS	Expiration of Term of Service
FAST	Functional Academic Skills Training
FFGE	Fully Funded Graduate Education
FY	Fiscal Year
GED	General Equivalency Diploma
ILIDB	Installation Level Integrated Database
MEPCOM	Military Entrance Processing Command
MGIB	Montgomery GI Bill
MOS	Military Occupational Specialty
NCO	Non-commissioned Officer
NPV	Net Present Value
OCONUS	Outside the Continental United States
OLS	Ordinary Least Squares
PCS	Permanent Change of Station
PEF	Active Duty Personnel Edit File.
PERSCOM	United States Total Army Personnel Command

Acronym	Definition
PRS	Participation Reasons Scale
SADP	Survey of Active Duty Personnel
SAS	Statistical Analysis System
SAT	Scholastic Achievement Test
SDT	Self Development Test
SIDPERS3	Standard Installation/Division Personnel System 3
SOC	Servicemembers Opportunity Colleges
SOCAD	Servicemembers Opportunity Colleges Army Degree
SPSS	Statistical Package for the Social Sciences
SRB	Selective Reenlistment Bonus
SSMP	Sample Survey of Military Personnel
SSN	Social Security Number
TA	Tuition Assistance
TAPDB	Total Army Personnel Database
UIC	Unit Identification Code
VEAP	Veterans Educational Assistance Program
VOLED	Voluntary Education